



GREEN AUDIT REPORT 2021-22



UNIVERSITY OF SCIENCE & TECHNOLOGY MEGHALAYA Accredited 'A' Grade by NAAC

ENVIRONMENT AUDIT COMMITTEE

Sl No	Name and Affiliation	Designation
1	Prof J.N. Ganguli, Professor, Dept of Chemistry	Chairman
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5	Dr Lalit Saikia, Asst Professor, Dept of Earth Science	Member
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9	Mr Shamim Goney, Deputy Registrar (Administration)	Member

Preface

University of Science & Technology Meghalaya is always concerned with the environmental issues to receive the best of attention. Improvement of environmental quality is one of the primary objectives of the University and towards achieving a better environmental health, a self-enquiry on the environmental quality in the campus has been made. This status report is third of its kind and expects that subsequent enquiry will be made on a periodic interval to keep us aware of the environmental status. The Environment Audit Committee constituted by USTM for the year2021-2022 deliberated on various environmental issues, identified gaps and suggested measures for improvement. It is always heartening to see incremental progress shown due to efforts of University authority. Documentation of the status of environment is an essential component for developing a holistic concept of a University. This report is a compilation of records available as well as new data/information generated as a part of audit.

It is to be admitted that there are limitation in compilation because concept of green audit had late entry into the University system. However this compilation provides an overall insight into the status of campus.

The effort of the committee is commendable in arriving at some important observations which will have definite contribution in our effort for a better environment.

LAND COVERAND LAND USE

Land use / Land cover is result of combined activities of physical and human activities. Land use and Land cover change detection is essential for understanding of physical environment, ecological process, soil erosion, deforestation and also helpful in planning purposes. The landscape of USTM is hilly in nature. Various academic departments, hostels, auditorium come up at the barren hills while the large portion is left as natural green cover. After preparing LULC map form Google Earth shows a total of 88.85 acres of land in the main campus of which 44.55 acres are under greenery, 5.878 acres under unconstructed areas, 2.18 acres covers by playground and 4.816 acres under marshy land and water bodies. Organized plantations in the campus are mainly along the internal roads and together with the different academic departments, they add to the overall green cover. The greenery including natural forests, garden and plantations, form 50.18 percent of total area. USTM campus home to wide diversity of aquatic flora and fauna. Efforts have been made in the campus to conserve natural forests.

SL.NO.	CATEGORIES	AREA (ACRES)	PERCENTAGE
1	Admin Block	0.121	0.136
2	Amenity Centre	0.109	0.123
3	Academic Blocks	2.909	3.274
4	Bus Stand	0.019	0.021
5	Canteen	0.53	0.597
6	Central Auditorium	1.676	1.886
7	Construction Site for Medical College	5.103	5.743
8	Culvert	0.049	0.055
9	Drains	0.142	0.160
10	Gate	0.008	0.009
11	Hut	0.008	0.009
12	Kasturba Girl's Hostel	0.165	0.186
13	Over Foot Bridge	0.006	0.007
14	Pascal Girl's Hostel	0.152	0.171
15	Pedestrian Step Road	0.16	0.180
16	Residential Area	0.114	0.128
17	Retaining Wall	0.273	0.307
18	Workshop	0.159	0.179
19	Road	8.441	9.500
20	Rock	0.104	0.117

Table 1: LULC categories in campus

21	Site (Medical College Hospital)	5.554	6.251
22	SSb Boy's Hostel	0.364	0.410
23	Stairs	1.019	1.147
24	Temporary Shed	0.152	0.171
25	Transformer	0.006	0.007
26	TSB Hostel	1.032	1.162
27	USTM Main Gate	0.105	0.118
28	USTM Play Ground	2.184	2.458
29	Wall	0.753	0.847
30	Wifi Tower	0.011	0.012
31	Playground	2.18	2.454
32	Marshy Area	2.489	2.801
33	Pond	2.104	2.368
34	Water bodies	0.223	0.251
35	Barren Hill	0.776	0.873
36	Open Space	4.596	5.173
37	Parking Area	0.506	0.569
38	Botanical Garden	0.101	0.114
39	Forest	25.294	28.468
40	Garden	0.538	0.606
41	Herbal Garden	1.27	1.429
42	Natural Vegetation	5.645	6.353
43	Nursery Hut	0.037	0.042
44	Plantation	11.663	13.127
	Total	88.85	100.000

Source: Google Earth, USTM Master Plan & Field survey.

Built up environment

Table 1shows different types of LULC area. It is found that a total of about 31.428acres (35.371 % of total) are under the constructed area, of which hostels, roads, and academic departments form a significant part. In absence of available plain area for further new constructions, hills were used for construction of medical colleges and hospitals. In general, the campus presents a perfect environment with lush green cover with many varieties of flora. A peaceful environment is an improvement in recent times by conserving surrounding green cover.



Figure 1: Detail LULC components of USTM Campus, Meghalaya, India



Figure 2: Percentage distribution of LULC classes.

























ENVIRONMENT

Noise level

A sound level meter was used to measure noise level at different locations of USTM campus during working hours in the Month of December2021. Results are shown in Table 1.

Table 1. Noise level in campus

Sl no	Location	Minimum	Maximum	Average level
		level	level (dB)	(dB)
		(dB)		
1	Central Library	40.2	61.4	58.5
2	Amenity Centre	61.2	71.3	66.2
3	Gyan Circle	48.1	90.7	57.8
4	Corridor, H block	43.5	54.4	50.2
5	In front of G block	51.6	56.4	53.1
6	Administrative block	52.6	57.7	54.7
7	NearIQAC office	44.3	53.2	45.3
8	Block C	53.1	66.1	54.2
9	Block E	44.6	59.2	55.1
10	PrakrityPathshala	30.8	44.2	42.5





Central Pollution Control Board has laid down the permissible noise level in India for different areas. In industrial areas, the permissible limit is 75 dB for daytime and 70 dB at night. In commercial areas, it is 65 dB and 55 dB while in residential areas it is 55 dB and 45 dB during daytime and night respectively. In silent zone, permissible limit in day time is 50 dB and in night time the value is 40 dB. Causes of noise at different locations of USTM campus are shown in Table 2.

Sl no	Location	Source of noise
1	Central Library	Movement of Ceiling fan, Whispering by students,
		movement of chairs by students
2	Amenity Centre	Gossiping/ talking by customers (mainly students and
		faculties), Chair movement, sound from generator
3	Gyan Cirle	Movement of vehicles
4	Administrative block	Talking
5	Block C, E	Human movement, Talking, sound from generator
6	In front ofblocks	Human movement, Talking, Birds
7	PrakrityPathshala	Birds

Table 2. Sources of noise

Apart from a few locations where construction work is going on, noise level in maximum key locations is below 50 dB. Noise level is more when University buses enters (8.30 AM - 8.50 AM) and leaves (4.15 PM - 4.20 PM) the campus.

Water Quality Status



There are natural water bodies in the university campus. Overall view of the water bodies is good and support aquatic birds and other organisms. Major threat to water quality in the water bodies are sediments from construction work and/ or cutting of hills for development purpose.

Turbidity

Turbidity is a measure of clarity of a liquid. If is an optical characteristic of water and is an expression of the amount of light that is scattered. Turbidity makes water cloudy or opaque. Turbidity of water in ponds of USTM campus was estimated using a Secchi Disc in Nephelometric Turbidity Unit.



Table 3. Turbidity of water samples

Sl no	Location	Turbidity (NTU)
1	Pond near park	11
2	Pond near girls' hostel	25

Turbidity of waterbody near the Girls' hostel is comparatively more due to construction activities, sediment transport and decomposition of leaves etc.

Water pH

pH is a measure of how acidic/basic water is. The range goes from 0 to 14, with 7 being neutral. pH of less than 7 indicate acidity, whereas a pH of greater than 7 indicates a base. The pH of water is a very important measurement concerning water quality.pH of water bodies and piped water in USTM campus was estimated using pH meter. The results are shown in Table below:

Table 4. pH of water samples

Sl no	Sample	pH value
1	Pond water	6.4
2	Piped water-1	7.5
3	Piped water-2	7.6

pH was found slightly acidic in pond water whereas pHwas slightly basic in piped water samples

Solid waste generated from shops, canteens etc.						
		Food		Amount		Suggestions/
Name of	Туре	taken by	Major waste	of waste	Disposal site/	requirements
shop		(no of	generated	in a	mechanism	(by shop
		persons		day(Appr		keeper/manage
		in a day)		OX.)		r)
	Food		Food waste,	<i>c</i> 0.1		Daily waste
Techno	Canteen	500	plastic, paper	60 kg	Near hostel	collection and
Cafe					block B	proper
	F 1		D' 11		0 11	management
Umbon	Food	150	Disposable	10 ka	Carried by	Bigger dustbin
Urban	Canteen	130	cups, plastic,	10 Kg	thrown in the	should be
JUNCTION			(peels)		bin in front of	provided
			(peers)		hostel block B	
Chai Lo	Food	60	Paper	10 kg	Disposed at	Regular nick-
	canteen	00	cups/glass	TOKS	designated	in
	cunteen		straws, food		place	۳p
			, , , , , , , , , , , , , , , , , , , ,		Wastes are	Regular
Biryani	Food	50	Paper,	20 kg	carried by	collection and
House	canteen		Plastics, food	C C	cleaners and	proper
			waste		thrown at the	management
					backside of	-
					boys hostel	
			Paper,		Collected at	Regular
JB Food	Food	25	Plastics, food	10 kg	dustbin and	collection and
corner	canteen		waste		then thrown at	proper
					front side of	management
			D (1	new hostel	
Medishop	Medisho		Paper etc.] 11-	Collected by	Regular
& Health	р			кg/week	cleaner	collection,
Care						proper
		Sol	id waste generat	ed in hostel	2	management
		Food	Average		<u> </u>	
Hostel	No of	prepared	amount of	Maior	Waste	Other
1105001	boarders	for	waste	waste	disposal	comments
	bourders	(persons)	generated in	generated	mechanism	comments
		(persons)	a day	generatea		
Hostel					Collected at	No major
Block A	450	420-430	75 kg	Wastage,	dustbin, then	problem as of
TS Boys				food	taken by local	now
Hostel				waste	people for pig	
					etc.	
Hostel	350	325340	65 kg	Food	Taken by	-do-
Block B				waste,	local people	
					for pig etc.	

SS Boys Hostel				wastage, plates		
Girls Hostel 1	300	275 285	50 kg	Food waste	Feeding the domestic animals	
Girls Hostel 2	50	45-50	10 kg	Food waste		

Solid waste generated in academic blocks/ buildings (information collected in the afternoon in normal working days)

Name of block	Total no of dustbins inside the	Amount of waste	No of dustbins
	building	in one	outside the
		dustbin(Approx.)	block
А	5	2kg	2
В	5	Less than 1 kg	1
С	13	2 kg	2
D	9	Less than 1 kg	1
E	7	1 kg	1
F	6	1 kg	2
G	11	Less than 1 kg	2
Н	7	1 kg	2
Ι	4	Less than 1 kg	1
J	3	1 kg	1
K	3	Less than 1 kg	1
L	2	Less than 1 kg	1
М	2	Less than 1 kg	1
Annex 1	2	1 kg	0

Total solid waste generated from all shops in a day: 100 kg (Approx.) Total solid waste generated from all hostels in a day: 190 kg (Approx.) Total solid waste generated from all other blocks/buildings in a day without any event/ function: 30 kg (Approx.)

Biodiversity

Conservation of biodiversity is an important global challenge to ensuring future sustainability. Biodiversity not only supplements our lives through economic, scientific and cultural aids, but more importantly, it maintains the functional and ecological balance of the environment. As such it is considered as one of the key pillars of sustainable development. Despite its important roles in sustainable development, biodiversity and its ecosystem services continue to be degraded and lost at unprecedented rates. The recent regional assessment reports by the "Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)" found that biodiversity is in decline in all regions of the world.

The world's population is projected to increase from around 7.6 billion today to close to 10 billion people by 2050. The corresponding global demand for food is estimated to grow by 50 percent during this period, introduction enormous pressure on productive land, particularly in developing countries. Land-use changes will further result in a loss of valuable habitats, land degradation, soil erosion, a decrease in clean water and the release of carbon into the atmosphere. The Global Forest Resources Assessment (FRA), coordinated by FAO, found that the world's forest area decreased from 31.6 percent of the global land area to 30.6 percent between 1990 and 2015, but that the pace of loss has slowed in recent years.

As such, a landmark event "United Nations Decade on Ecosystem Restoration, 2021–2030" was apprehended as a means of highlighting the need for greatly increased global cooperation to reestablish degraded and destroyed ecosystems, contributing to efforts to combat climate change and safeguard biodiversity. The 6th Global Biodiversity Summit of Local and Subnational Governments including representatives of the countries parties, observer countries and international organizations was held in Sharm el-Sheikh, Egypt, in parallel to Convention on Biological Diversity (CBD) COP 14, November 2018 to negotiate agreements and commitments that give impulse to the conservation and sustainable use of biodiversity as well as the implementation of the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets.

As a part of the action towards the conservation of biodiversity and to promote a green campus, various assessmentsare being made toreinforcethe biodiversity wealth within the campus, starting with the construction of Botanical Garden, Green house, Nursery, Biodiversity Parkand also proper documentation of existing plant species (Figure. 1A & 1B). Over the past years, several efforts fortree plantation drives havealso been carried out by the University under teacher-student initiative within the campus (Figure. 1C). A more detail account on the campus biodiversity, both floral and faunal was given in (Table 1, 2 and 3).



Figure 1: A) Establishment of Botanical Garden, Green house, Nursery; B) Biodiversity Park and C). Plantation drives within the University Campus

Floral Diversity in Campus

The primary mission for encouraging the USTM Campus vegetation is to create a green campus, enhance the educational, societal awareness and aesthetic value of the campus. University of Science and Technology Meghalaya campus is located within the geo-coordinates of latitude 26.103° N and longitude 91.846°E in Meghalaya, India. It encompasses an area of about 400 acre. The campus is situated in a hilly terrain and is covered by tropical

moist deciduous forest comprising of wide variety of species. Proper documentation for the existing species has been conducted by survey method in the USTM campus in the year 2018-19, which led to identification of as many as 40 herbs and shrubs, 45 Species of tree. Most of the tree species are growing naturally and few of them are either exotic or planted in different areas within the campus (Figure 2 and 3). However the present lists of tree, shrubs and herbs species represented only less than 50% of the total species actually available in USTM campus. Further most of the herbs and shrubs species present within the campus are either medicinal or used as vegetables. But proper documentation of most of the species are still lacking. As such continuous efforts are being made for proper documentation of the species, so that peoples in general and students in particular, can use them for taxonomic and research purpose. Proper maintenance of vegetation within the campus will also serve in providing an extended classroom and living laboratory for the students. Hence, proper conservation initiative is required for these species in the campus. It was further hoped that, the all university campuses will together act as a single large entities in putting a huge impacts on the environment and overall ecosystem sustainability.



Delonix regia

Terminalia arjuna



Figure 2: Few important Tree species found within the USTM campus







Ricinus communis

Ixora coccinea

Setaria viridis



Yucca filamentosa



Cycas revoluta



Livistona japonica



Hevea brasiliensis



Costus speciosus



M. malabathricum

Figure 3: Few important herb, shrub and ornamental species found within the USTM campus



Aquilaria malaccensis (Agarwood tree)



Clusia rosea (Autograph Plant)





Dendrolobium umbellatum (Golden horse plant) Terminalia mantaly (Madagascar plant)



Dicranopleris linearis (False Staghorn fern)



Plumeria alba (Temple tree)

Figure 4: Few important herb, trees and ornamental species found within the USTM campus

Floral diversity details

Table1: Diversity of Herb species

SN	Common Name	Scientific Name	Family
1	Common trumpetvine	Allamanda cathartica	Apocynaceae
2	Setariapallide-fusca	Arundinella bengalensis	Poaceae
3	Snap Ginger	Alpinia calcarata	Zingiberaceae
4	Common rabi weeds of India	Blumealacera L.,	Asteraceae
5	Indian timber bamboo	Bambusatulda	Poaceae
6	Papper flower	Bougainvillea spectabilis Wild.	Nyctaginaceae
7	Asian pigeonwings	Clitoriaternatea	Fabaceae
8	Croton plant	Croton tiglium	Euphobiaceae
9	Coleus	Coleus scutellarioides	Araceae
10	False Heather	Cuphea hyssopifolia	Lythraceae
11	Citronella Grass	Cymbopogon nardus	Poaceae
12	Bamboo	DendrocalamushamiltoniiNees.	Poaceae
13	False Staghorn Fern	Dicranopteris linearis (Burm.F.)	Gleicheniaceae
14	Pleomele dracaena	Dracaena reflexa Lam.	Asparagaceae
15	Cape Jasmine	Gardenia jasminoides	Rubiaceae
16	Cogon grass	Imperatacylindrica	Poaceae
17	Banana tree	Musa champaca Hort.	Musaceae
18	Basil plant	Ocimum sanctum	Lamiaceae
19	Phyllanthus	Phyllanthusnururi	Euphorbiaceae
20	Fence bamboo	Phyllostachysmannii Gamble	Poaceae
21	Mexican flame flower	Poinsettia pulcherrima	Euphorbiaceae
22	Devil's Backbone plant	Pedilanthus tithymaloides	Euphorbiaceae
23	Snake tongue	Sansevieriaroxburghiana	Asparagaceae
24	Yellow foxtail	Setariapallide-fusca	Poaceae
25	Tridax daisy	Tridaxprocumbens	Asteraceae
26	Broom grass	ThysanolaenaagrostisNees.	Poaceae
27	Dandotapala	Vernoniacinerea	Asteraceae
28	Suterberry	Zanthoxylum armatum DC	Rutaceae

Table 2: Diversity of Shrub species

SN	Common Name	Scientific Name	Family
1	Sentry plant	Agavaeamericana L.	Asperagaceae
2	Camellia	Camellia japonica	Theaceae
3	Indian shot	Canna indica	Cannaceae
4	Key lemon	Citrus aurentifolium	Rutaceae
5	Grapefruit plant	Citrus paradise Macf.	Rutaceae
6	Variegated croton	Codiaeumvariegatum L Bl.	Euphorbiaceae
7	Spiral ginger	Costus specious	Costaceae
8	Giant Calotrope	Calotropis gigantean.L	Apocynaceae

9	Autograph plant	Clusia rosea	Clusiaceae
10	Golden Horse Bush	Dendrolobium umbellatum (L.)Benth.	Fabaceae
11	Duranta	Duranta erecta L.	Verbenaceae
12	Areca Palm	Dypsis lutescens	Arecaceae
13	China rose	Hibiscus rosa-losinensis L.	Malvaceae
14	Island Musk	Euodia hotensis Forst.	Rutaceae
15	Giant False Agave	Furcraea foetida L.	Asparagaceae
16	Fishwort Plant	Houttuynia cordata L.	Saururaceae
17	Jungle geranium	IxoracoccineaRoxb.	Rubiaceae
18	Malabar melastome	Melastomamalabathricum	Melastomiaceae
19	Bangkok Rose	Mussaenda philippica	Rubiaceae
20	Red flag bush	M.erythrophyllaSchumach & Thonn	Rubiaceae
21	Castor oil plant	Ricinuscommunis	Euphorbiaceae
22	Rose plant	Rosa indica	Rosaceae
23	Needle wood tree	Schimawallichi DCKorth.	Transtromiaceae
24	Hairy-fruited eggplant	Solanumferox L.	Solanaceae
25	Pinwheelflower	Tabernaemontanadivericata L R.Br.	Apocynaceae
26	Giloy Plant	Tinospora cordifolia	Mttenispermceae
27	Indian paint	Tradescantia tricolor	Commelinaceae
28	Yucca plant	Yucca aloifoliavariegataNaudin	Asparagaceae

Table 3:	Diversity	of Tree	species
			~r ~

SN	Common Name	Scientific Name	Family
	Australian	Acacia auriculiformis A. Cunnn.	Mimosaceae
1	acacia	Ex. Benth	Williobaeeae
2	Golden Mimosa	Acaia baileyana	Fabaceae
3	Lebbeck tree	Albizia lebbeck	Fabaceae
4	Kalkora Mimosa	Albizia kalkora	Fabaceae
5	Golden Trumpet	Allamanda cathartica	Apocynaceae
6	Devil tree	Alstoniascholaris L R. Br.	Apocynaceae
7	Burflower-tree	Anthocephaluscadamba	Rubiaceae
8	Agar tree	AquilariamalacensisLamk.	Thymelaeceae
9	Norfolk pine	Araucaria excelsa R.Br.	Araucariaceae
10	Norfolk Island Pine	Araucaria heterophylla	Araucariaceae
11	Betelnut tree	Areca catechu L.	Aracaceae
12	Jackfruit	Artocarpusheterophyllus Lam.	Moraceae
13	Breadfruit plant	Artocarpuschama	Moraceae
14	Neem Tree	Azadirachtaindica A. Juss	Meliaceae
15	Camel's foot tree	Bauhinia variegata L.	Caesalpiniaceae
16	Polytail Palm	Beaucarnea recurvata	Asparagaceae
17	Bishmarck plant	BishmarekianobilisHildebr	Aracaceae
18	Palmyra palm	Borassuaflabelliformis L.	Aracaceae

19	Golden shower	Cassia fistula L. Caesalpinia	
20	Pink shower tree	Cassia nodossaBuch. Ham. Ex Roxb.	Caesalpiniaceae
21	Araca palm	Chrysalidocarpuslutescense H. Wendl	Aracaceae
22	Coconut tree	Coccosnucifera L.	Aracaceae
23	Sago palm	Cycas revolute Thunb.	Cycadaceae
24	Fukien tea tree	Carmona retusa L.	Boraginaceae
25	Indian rosewood	Dalbergiasissoo	Fabaceae
26	Gulmohur	DelonixregiaBojr. Raf.	Caesalpiniaceae
27	Pongamoiltree	Derris indica	Fabaceae
28	Butterfly palm	DypsislutecensBeentje&Dransf	Aracaceae
29	Indian olive	Elaeocarpusfloribundus Bl., Bijdr.	Elaeocarpaceae
30	Amla tree	Emblica officinalis	Euphorbiaceae
31	Monkey pod tree	Enterolobiumsaman	Fabaceae
32	Indian corel tree	ErythrinaindicaLamk.	Papilionaceae
33	Benjamin fig tree	Ficusbenjamina L.	Moraceae
34	Common fig plant	Ficushispida	Moraceae
35	Sacred fig	Ficusreligiosa	Moraceae
36	Silver oak	Grevillea robusta R. Br.	Proteaceae
37	Para rubber tree	HeveabrasilliensisMuell-Arg. Moraceae	
38	Juniper tree	Juniperus semiglobosa	Cupressaceae
39	Thai crape myrtle	Lagerstroemia floribunda	Lythraceae
40	Indian ash tree	<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae
41	Litchi tree	Litchi chinensesSonnar	Sapindaceae
42	Litsea tree	Litseamonopetalal Roxb. Pers	Lauraceae
43	Mountain pepper	Litseacubeba	Lauraceae
44	Fasttech Fan Palm	Livistonachinensis L.	Aracaceae
45	Drum strick tree	MoringaoleiferaLamk. L.	Moringaceae
46	Deodar tree	Monon longifolium L.	Annonaceae
47	Mulberry tree	Morus nigra L.	Moraceae
48	Kamala tree	Mallotus paniculatus (Lam.) Mull.Arg.	
49	Dhobi Tree	Mussaenda frondosa	Rubiaceae
50	Pygmy date palm	Phoenix robelenii O' Brien Aracaceae	
51	Temple tree	Plumeria alba L.	Apocynaceae
52	False ashoka tree	PolyalthialongifoliaSonnerThw.	Annonaceae
53	Guava plant	Psidiumguajava L. Myrtaceae	

54	Needlewood tree	Schimawallichii	Theaceae
55	Jumbolan tree	Syzygiumcumini LSkecls.	Myrtaceae
56	Rain tree	Samanea saman	Fabaceae
57	Arjun tree	Terminaliaarjuna DC W. & A.	Combretaceae
58	Thuja plant	Thujaorientalis L.	Cupressaceae
59	Foxtail Palm	Wodyeia bifurcata	Arecaceae
60	Ber tree	ZiziphuszujubaLamk.	Rhamnaceae

Faunal diversity in Campus

The sprawling campus of USTM boasts of very rich and endemically important faunal species. The phylum Arthropod is one of the largest fauna existing in the campus followed by a rich diversity of hill stream fishes. The campus also witnesses several birds for the rich variety of green cover. USTM also has developed artificial fish culture facility of Koi carp and *Anabas testudines* in biofloc facility which is used for entrepreneurship development. Enhanced efforts and maintenance for conservation of all the existing species would encourage students to take up biological and ecological studies of the species to understand them better.

List of Vertebrates

Mammals :

SL No.	Common name	Scientific name
1	Rhesus macaque	Macaca mulatta
2	Leopard cat	Prionailurus bengalensis
3	Jungle cat	Felis chaus affrinis
4	Grey Mongoose	Herpestes edwardsii
5	Small Indian Mongoose	Herpestes javanicus
6	Golden Jackal	Canis aureus
7	House shrew	Suncus marinus
8	White-tailed mole	Parascaptorleucura
9	Orange-bellied Himalayan Squirrel	Dremomys lokriah
10	Indian Flying Fox	Pteropus giganteus
11	Indian Leaf-nosed Bat	Hipposideroslankadiva

Birds :

SL No.	Common name	Scientific name
1	White-breasted waterhen	Amaurornisphoenicurus
2	Cattle egret	Bubulcus ibis
3	Little egret	Egrettagarzetta
4	Great egret	Ardea alba
5	Indian pond heron	Ardeolagrayii

6	Spotted dove	Spilopelia chinensis
7	Rose-ringed parakeet	Psittaculakrameri
8	Common goldenback	Dinopiumjavanense
9	White-throated kingfisher	Halcyon smyrnensis
10	Lineated barbet	Megalaimalineata
11	Blue-throated barbet	Megalaima asiatica
12	Black kite	Milvus migrans
13	Brown fish owl	Ketupazeylonensis
14	Eastern jungle crow	Corvus levaillantii
15	House crow	Corvus splendens
16	Asian koel	Eudynamysscolopaceus
17	Lesser coucal	Centropus bengalensis
18	Black drongo	Dicrurusmacrocerus
19	Ashy drongo	Dicrurusleucophaeus
20	Ashy woodswallow	Artamusfuscus
21	Black-hooded oriole	Oriolusxanthornus
22	Common myna	Acridotheres tristis
23	Jungle myna	Acridotheresfuscus
24	Asian-pied starling	Gracupica contra
25	Chestnut-tailed starling	Sturniamalabarica
26	Red-vented bulbul	Pycnonotuscafer
27	Red-whiskered bulbul	Pycnonotusjocosus
28	Oriental-magpie robin	Copsychussaularis
29	White wagtail	Motacilla alba
30	Asian palm swift	Cypsiurusbalasiensis
31	Indian roller	Coracias benghalensis
32	Green bee-eater	Meropsorientalis
33	Chestnut-headed bee-eater	Meropsleschenaulti
34	Purple sunbird	Cinnyris asiaticus
35	Great tit	Parus major
36	House sparrow	Passer domesticus
37	Eurasian tree sparrow	Passer montanus
38	White-rumped munia	Lonchura striata

Lizards:

Family	Scientific name	
Agamidae	1	Calotes versicolar
1.180	2	Sitana ponticeriana
Gekkonidae	3	Hemidactylus frenatus
Scincidae	4	Sphenomorphus maculatus
Scincidae	5	Eutropismulti fasciata
Varanidae	6	Varanus bengalensis

Amphibia :

Family		Scientific Name
Ichthyophiidae	1.	Ichthyophis garoensis
Megophryidae	2.	Megophrys parva
Bufonidae	3.	Duttaphrynus melanostictus
Microhylidae	4.	Microhyla ornata
Ť	5.	Rohanixalus vittatus
Rhacophoridae	6.	<u>Philautus garo</u>
-	7.	Polypedates leucomystax
	8.	Fejervary ateraiensis
Diamogloggidag	9.	Fejervary anepalensis
Dicrogiossidae	10.	Hoplobatrachus tigerina
	11.	Euphlyctes cyanophlyctes
Ranidae	12.	Hylarana leptoglossa
	13.	Humerana humeralis

Fishes:

Family	Common name		Scientific name
	Indian flying barb	1	Esomusdanricus
Cvprinidae	Giant danio	2	Danio aequipinnatus
-) [Moustached danio	3	Danio dangila
	Zebrafish	4	Brachydanio rerio
	Mola carplet	5	Amblypharyngodon mola
	Common carp	6	Cyprinus carpio
	Copper mahseer	7	Neolissochilushexagonolepis
	Labura	8	N. hexastichus
	Swamp barb	9	Puntius chola
	Shalyni barb	10	Puntius shalynius
Balitoridae	Gray's stone loach	11	Balitora brucei
	Mottled zipper loach	12	Acanthocobitisbotia
Cobitidae	Queen Loach	13	Botiadario
	Guntea loach	14	Lepidocephalusguntea

List of Invertebrates

Spider:

Family		Scientific name
	1	Leucaugepondae
Tetragnathidae	2	Tetragnathamandibulata
	3	Leucaugedecorata
Thomisidae	4	Misumenavatia
	5	Camaricusformosus
	6	Amyciaeaforticeps
Hersilidae	7	Hersiliasavignyi
Nephilidae	8	Nephila pilipes

	9	Herenniamultipuncta
Araenidae	10	Gastercanthakuhli
	11	Cyrtophorafeai
	12	Neoscona nautica
	13	Gasteracanthadalyi
	14	Neoscona mukerjei
Oxyopidae	15	Oxyopesrufisternum
	16	Oxyopesshweta
Salticidae	17	Scytodesthoracica
Lycocidae	18	Hippasasp
	19	Lycosa mackenziei
Theraphosidae	20	Morphospecies sp.
	21	Chrysso pulcherrima
Theridiidae	22	Chrysso nigra

Moths :

Family		Species	Scientific name
A	1	Tiger moth	Asura sp.
Arctiidae	2	Marble white moth	Nyctemeraadversata
	3	Beet web worm moth	Spoladearecurvalis
	4	Rice leaf folder	Cnaphalocrocismedinalis
	5	Yellow Peach Moth	Conogethespunctiferalis
Crambidaa	6	Grass moth	Endocrossisflavibasalis
Crambidae	7	Crambid moth	Glyphodescanthusalis
	8	Mung Bean moth	Marucavitrata
	9	Rice caseworm	Parapoynxstagnalis
	10	Grass moth	Botyodesasialis
Erebidae	11	Snouted Tiger moth	Asotacaricae
	12	Tussock Moth	Lymnantriadispar
Geometridae	13	True loopers	Eucyclodes sp.
	14	Loopers moth	Ruttelleronapallicostaria
	15	True loopers	Scopula sp.
	16	Geometrid Moth	Eucyclodes divapala
Hyblaeidae	17	Teak defoliator moth	Hyblaea puera
Noctuidae	18	Owlet Moth	Gramodesgeometrica
Nolidae	19	Borer	Beanaterminigera
Pyralidae	20	Snout Moth	Pyralisfarinalis
Sphingidae	21	Tiger Hawk Moth	Hippotion sp.
Thyrididae	22	Sapodilla Borer	Banisiamyrsusalis

Butterfly diversity:

Family		Scientific name
	1	Baorisfarri
	2	Barbobevani
	3	Caltoris kumara
	4	Caltorisphilippina
	5	Caltorisplebeia
	6	Capronaransonnetti
	7	Cephrenesacalle
	8	CupithaPurreea
	9	Halpehomolea
	10	Lambrixsalsala
Hesperiidae	11	Notocryptacurvifascia
	12	Oriensgola
	13	Parnarabada
	14	Parnara guttata
	15	Pelopidas mathias
	16	Pseudocoladenia dan
	17	Psolosfuligo
	18	Sarangadasahara
	19	Suastusgremius
	20	Tagiadesjapetus
	21	Udaspesfolus
	22	Amblypodiaanita
	23	Antheneemolus
	24	Arhopalaatrax
	25	Arhopalacentaurus
	26	Caleta caleta
	27	Castaliusrosimon
	28	Heliphorousepicles
	29	Hypolycaenaerylus
	30	Ionolyte helicon
Lycaenidae	31	Jamidesbochus
	32	Lampidesboeticus
	33	Loxuraatymnus
	34	Nacadubahermus
	35	Prosotasnora
	36	Pseudozizeeria core
	37	Pseudozizeeriamaha
	38	Viracholaisocrates
	39	Zeltusamasa
	40	Zinas patodara

	41	Zizeeriakarsandra
	42	Zizinaotis
	43	Ariadne areadne
	44	Athymainara
	45	Athymaperius
	46	Athymaranga
	47	Cethosiacyane
	48	Charaxesa grarius
	49	Cirrochroaaoris
	50	Cynitialepidea
	51	Cyrestisthyodamas
	52	Danaus crysippus
	53	Elymniascaudata
	54	Elymniashypermnestra
	55	Elymniasmalclas
	56	Euploea core
	57	Euploeasylvester
	58	Euthaliaaconthea
	59	Euthalialubentina
	60	Hypolimnasbolina
	61	Junoniaalmana
	62	Junoniaatlites
Nymphalidae	63	Junoniahierta
	64	Junoniaiphita
	65	Junonialemonias
	66	Kaniska canace
	67	Lebadeamartha
	68	Lethe confusagambara
	69	Melanitis
	70	Melanitisleda
	71	Melanitisphedima
	72	Melanitiszitenius
	73	Mycalesismineus
	74	Mycalesisperseus
	75	Mycalesis sp.
	76	Neptisclinia
	77	Neptishylus
	78	Neptis nata
	79	Orsotriaenamedus
	80	Pantoporiahordonia
	81	Phalantaphalantha
	82	Symbrenthialilaea
	83	Tanaecialepidea

	84	Tirumala limniace
	85	vagransegista
	86	Vindulaerota
	87	Ypthimabaldus
	88	Ypthima striata
	89	Ypthimatabella
	90	Graphiumsarpedon
	91	Papilio castor
Papilionidae	92	Papiliodemoleus
	93	Papiliohelenus
	94	Papiliopolytesromulus
	95	Appiasalbina
	96	Appiaslibythea
Pieridae	97	Appiaslyncida
	98	catopsiliapomona
	99	Catopsiliapyranthe
	100	Deliaspasithoe
	101	Euremaandersonii
	102	Eurema balanda
	103	Euremahecabe
	104	Gandacaharina
	105	Leptosianina
	106	Pieris canidia
Diodinidae	107	Abisarabifasciatasuffusa
Kiodinidae	108	Zemerousflegyas

Grasshopper

Family		Scientific name
	1	Oxyayezonsis
	2	Oxyahylahyla
	3	Oxya chinensis
	4	Phlaeobainfumata
	5	Trimerotropispallidipennis
	6	Trilophidiaannulata
	7	Spathosternumprasiniferum
	8	Concephalussemivittatus
	9	Concephalusnigropleurum
	10	Hexacentrus unicolor
	11	Euconocephalus pallidus
	12	Atractomorphacrenulata
	13	Atractomorphasimilis
	14	Tetrix subulata

Zooplankton

Types		Scientific name
	1	Centropyxis
	2	Dinobryon
	3	Difflugia
Protozoans	4	Eudorina
	5	Euglypha
	6	Pandorina
	7	Vorticella
	8	Brachionus
	9	Asplanchna
	10	Chromogaster
	11	Euchlanis
	12	Filinia
	13	Hexarthra
	14	Keratella
	15	Lecane
	16	Mytilina
	17	Monostyla
	18	Polyarthra
	19	Rotatoria
	20	Synchaeta
Rotifera	21	Trichocera
	22	Alonella
	23	Bosmina
	24	Canthocampus
	25	Chydorus
Copepods	26	Daphnia
	27	Moinasida
	28	Simocephalus
	29	Diaphanosoma





Figure 4: (A) Establishment of Bio Floc facility at the USTM campus, (B) Yield of biofloc – *Anabas testudineus*

Energy and Electricity

Energy and electricity audit covers the aggregate consumption of power on the campus. It covers consumption of natural gas and fuels (diesel) in the different academic and administrative blocks, shopping complex, hostels and auditorium. It tries to decipher if renewable energy sources like solar energy facilities are available on the campus. Moreover, since LED lights are more environmentally sustainable than CFLs and fluorescent bulbs, the audit evaluates the percentages of CFL, LED (bulb and tube light) and fluorescent (bulb and tube light) used on the campus.

In the words of Energy Conservation Act, 2001, Energy Audit is "the verification, monitoring and analysis of the use of energy including submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption".

The monthwise unit consumption in the campus during 2021 and 2022 is shown in

Figure 1; In aggregate, the average monthly power consumption in the campus in 2021 was 51040 KVAH while in 2022 it is found 81950 KVAH.

Figure 2; The average monthly consumption for the year 2022 is higher is due to the addition of new facilities and new infrastructure.



Figure 1: Month wise unit consumption in 2021& 2022



Figure 2: Average monthly power consumption in 2021& 2022

The survey finds that:

- On average, the Administration block of the University has **70% LED** Tube light& Bulb, **20% of CFL light, 10% of fluorescent tube** light.
- On average, the Academic blocks of the University has 70% LED tube light, 11% of LED bulb, 44% of CFL light, 13% of fluorescent tube light and no incandescent &fluorescent bulb.

Solar Lighting:

The University also has standalone solar street light facility. It has 50 nos. of 12 Watt, 10 nos. of 15 Watt and 6 nos. of 30-Watt solar street lights. Recently, the University has also installed its own solar generating plant in the campus with a generation capacity of 5.2 kW of power. The University has also future plans of expanding this generation capacity by installing more solar plants.

An energy saving potential of **0.981 MU** per annum was observed, which is summarized as below. **It has been found an energy saving potential of about 23%.**

1. Retrofitting of 40W fluorescent tube lights with conventional ballast with 18W LED Tubes can save **12878.4 kWh** per year and financial saving of **Rs. 1, 21,057.**

2. 60W fan regulator can be replaced with new and energy saving efficient electric regulator which saves **7770kWh** per year and financial saving of **Rs. 73,038**.

3. Retrofitting old & inefficient split type AC with 5-star AC. The expected energy saving potential is **10754 kWh** per year and financial saving of **Rs. 1,01,088**

4. The monthly maximum (MD) recorded during January 2021 to December 2021, ranges from 140 kVA to

162 kVA. But the contract demand is 130 kVA. As per the tariff regulation, the consumer has to pay the

extra demand charges of more than Rs. 150 per kVA.

Rain Water harvesting & Bio-gas plant:

• USTM has installed a Rain Water Harvesting Plant at Boy's Hostel-B, having Capacity of 15000 Liters during rainy season and it will save the water pump

Consumption of 61.6 kWh and Energy Financial saving of Rs.580 per day.

Motion Sensor for Illumination & Day Light:

• USTM has installed the Motion sensors for the Illuminations at the Area of

Hostel Toilets and Administrative Block and it saving the energy consumption

in illuminations.

• At the Buildings of Block-G & Block-H has architectural designed for the coming of day light at the Class Rooms and it saving the illumination consumption during day time.

RECOMMENDATIONS

The following recommendations are made for short and medium term implementations.

- 1. To put in place a comprehensive waste disposal system. The system in place should be displayed in strategic positions to keep everybody aware.
- 2. Installation of separate, dustbins in a few locations to encourage segregation of wastes and separately collect the biodegradable and new biodegradation wastes.
- 3. In-house documentation and analysis of air, water and noise in the campus with validation by NABL accredited laboratory should be made at regular interval.
- 4. Installation of electric and water meters in all administration units, academic departments and hostels should be carried out.
- 5. In order to promote diversity, systematic plantations should be carried out in the campus emphasising on indigenous species.
- 6. Creation of "Green Fund" with individual and institutional contribution.
- 7. Awareness programme should be carried out at periodic intervals to ensure plastic free campus.
- 8. Replacement of CFL and other fluorescent lights with LED during next one year.
- 9. Expansion of generation of solar power should be up to 500 kW in next three years.

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