

**Progress Report**  
**On “ Propagation and Management of**  
**Bamboo” under GSDP course (2020-21)**

**Submitted by**



**Arunachal ENVIS Hub**  
**Department of Environment & Forests**  
**Government of Arunachal Pradesh**  
**Itanagar**

**Submitted to:**



**Government of India**  
**Ministry of Environment, Forests & Climate Change**  
**(MoEF&CC), EI-Division**  
**Agni Wing-650,6<sup>th</sup> floor**  
**Indira Paryavaran Bhawan**  
**Jor Bagh Road, New Delhi-110003 (India)**

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**Progress Report**  
**On**  
**“Green Skill Development Programme (GSDP) on**  
**Propagation and Management of Bamboo”**

A 240-hour Green Skill Development Programme (GSDP) on bamboo Propagation and Management’ was conducted at the Arunachal University of Studies (AUS) from 5<sup>th</sup> Dec 2020 to 15<sup>th</sup> Jan 2021 by the Arunachal Envis Hub, Dept. of Environment & Forests, GoAP. The programme is being funded by the union Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India.

The ENVIS Hub had identified Arunachal University of Studies (AUS) Namsai as Institute for impartation of Certificate Course for Green Skill Development Programme (GSDP) on “Propagation and Management of Bamboo 240 Hours as per allocation made through MoEF&CC, GoI.

All total 18 students have been trained under the programme and accordingly certificates were distributed for successfully completed the training programme.

**Inaugural Session:**

Inaugural programme of Green Skill Development Programme (GSDP) on Bamboo Propagation and Management for 240 Hrs. was held at Seminar Hall at Arunachal University of Studies (AUS), Namsai on 5<sup>th</sup> December 2020.

Augmenting the programme D. Dohu Robin in his address expressed integration of line departments like Industries, Agriculture, Horticulture, Textiles and Handicrafts and others to come up with plans for future way forward.

He further expressed satisfaction on learning that the AUS is engaging resource persons from the Rainforest Institute, Jorhat, and other renowned institutes for imparting training to the students.

The inaugural programme was attended by Vice Chancellor Prof. O.P.Sharma, Arunachal University of Studies; D. Dohu Robin, Director Environment and Climate Change

cum ENVIS Coordinator, DoEF Govt of Arunachal Pradesh; Dr. Rani Jha, Director of Science and Technology and Skill Development Programme Coordinator (Arunachal University of Studies); Kapil Bisht, Programme Coordinator (Arunachal University of Studies), Jumsor Rime, Assistant Director Textile and Handicraft Namsai; B.R. Dey, Assistant Director Industries Namsai; H.N.Dubey, Director Public Relation (Arunachal University of Studies); Dr. Chaowlani Manpoong, Resource Person and Assistant Professor (Agriculture), Arunachal University of Studies.

**The first week** (5th – 12th Dec 2020) of the training program was kicked off by a general introductory session of all the students in the morning [10.00AM] on the first day. This was initiated by Dr. Rani Jha, Director of Science & Technology, Agricultural Sciences, Skill Development Programme Coordinator along with Mr. Kapil Bisht, Programme coordinator, AUS, Namsai. An introductory session on types of Bamboo, its wide applications as building material, furniture making, cosmetics, handicraft manufacture, basketry, etc. was given.



*Pic: Dr. Rani Jha briefed about Bamboo and its usefulness.*

Trainees were found to be extremely interested and asked questions on how the training program will help them grow in their careers. The later part of the day was handled by Prof. B. Khongia, Ex-Professor, Horticulture, Assam Agriculture University, Jorhat. His vast

knowledge in the field of agroforestry and cultivation of Bamboo species was easily seen while he interacted with the young trainees.

*Pic: - Prof. B. Khongia, Ex-Professor, Horticulture, Assam Agriculture University, Jorhat lectured on agroforestry and cultivation of Bamboo species.*

Trainees got excited and discussed on Gibberellins, plant growth hormones and if it can be used for bamboo like others. Flowering stages were also discussed in due course. The days plan was to teach the trainees about the various propagation methods for Bamboo – first



theoretically and then proceed in the afternoon with the practical of how bamboo can be grown in field. As we all know that although Bamboo can be found easily in the front and backyard of almost every household in the North-East, it is surprising that almost none of them here are aware of all the possible methods for propagation for bamboo.



After telling the various techniques of growing bamboo additional knowledge was given on how to enhance the growth by the use of growth hormones which are commercially available.

The afternoon session was taken to the fields where Prof. Khongia along with Dr. Rani Jha, Skill Development Programme Coordinator, AUS have prepared for showing students how Bamboo can be Successfully taken as a career.



Traditionally bamboo is grown right from its roots in a pit (2ftx2ftx2ft) half filled with top-most fertile soil, inclined at 60 deg angle and then filled the rest with remaining soil. Preferred would be to use soil pre-mixed with decomposed cowdung [Traditional Method]. Another method is Layering, where lateral placing of nodes with fertile shoots are placed in soil 1/2ft and covered with soil [Layering Method].



Culm cutting is a tedious method of plantation where hole is made in between nodes and filled with Indole-3-butyric acid solution (preferred) [200mg in 1L water] or Boric acid solution to soak it thoroughly and placed it in a pre-prepared pit, cover with soil and let it grow.



The last method is Branching, where any number of bamboo can be grown from a single culm of bamboo by cutting it between 4-5 nodes and dipping it in solution of Indole-3-butyric acid for 2-3 min before covering with a mixture of soil, sand and decomposed cow dung followed by covering it all with a plastic bag. It is important to remember that no matter which method is used for propagation of bamboo, regular irrigation is a must in all.

The third day of the training was taken care by Prof. G. N. Hazarika, Ex-Director of Research, Assam Agriculture University, Jorhat and Prof. B. Khongia together. They both taught the trainees of the various cultivating practices and the choice of species in general in the region.

Dr. Chowhani Manpoong, Assistant Professor, Arunachal University of Studies took the fourth day class in the week. Being an agroforestry specialist and soil scientist, he told the students about different kinds of soil types, moisture requirements.



He then took all the trainees to a nearby bamboo cultivation area. Showing them the difference between the extent of soil moisture and hardness one encounters when in any other field to that of a bamboo area made all difference. It was clearly shown that bamboo plantation enhances the moisture content which would eventually be beneficial to the other plants in the vicinity.



The fallen off leaves from the bamboo also serves as a good eco-manure for a lot of plants. It has earlier been shown by farmers all over the world that the average production of garlic, turmeric, mushrooms etc. is found to be better. This is primarily due to the fact that bamboo leaves are rich sources of proteins and provide the required nutrients.





The fifth day of the week was more about vermicompost for productivity and enhancement of bamboo cultivation. This was followed by a class from Mr. Boppa Linggi, Assistant Professor at Arunachal University of Studies telling the trainees about various diseases that might infect bamboo. It is important to mention that bamboo plants are prone to very few kinds of infections.



Some of them are leaf blight. This is a phenomenon wherein the leaves start to become brown post maturing and slowly start to decompose and fall off the plant. The last day of the week was taken care by Dr. Rani Jha, Director of Science & Technology, Director of Agricultural Sciences and Skill Development Programme Coordinator at Arunachal University of Studies. She told the trainees of the origin of the work bamboo and classification in detail of the subfamily.



A clear difference between trees and grass (bamboo) was also been highlighted. A more pictorial representation of the various types of bamboo (running or clumping) under various temperature conditions around the world was shown during the day.



Why and how bamboo can be taken up as the career was emphasized. High-end products, bamboo in technology (electric powered tricycle), bamboo in cars (Lexus), textile products of bamboo and military applications all over the world was shown. The week ended with trainees getting motivated and seeing the potential of Bamboo cultivation and future of it.

### **Week-2 [13<sup>th</sup> – 19<sup>th</sup> Dec 2020] at AUS, Namsai**

After the exciting first week of the training program on Propagation and Management of Bamboo at the Arunachal University of Studies, the second week was focused more on the management of bamboo. The first day of this week begun with trainees getting introduced about the basics of Insects and Pests of Bamboo by Dr. Monjeet Sonowal, Assistant Professor at the Department of Zoology, Arunachal University of Studies. Students were taught the definition of what a pest or insect means, the broad classification of the animal kingdom and



the placement of insects and pests in it, followed by some of the common examples of each category of insects and pests varieties that infests various plants including bamboo.

The second day of the week was taken care by Mr. Abinash Hazarika, Panchajanya Kutir Udyog, Handicraft expert from Teok, Assam. He told the trainees that the bamboo items made by him were also displayed at various fairs in Delhi and Guwahati and are being sold at great price. This is primarily due to the ever growing awareness of people towards environmental benefits of bamboo and its products.



He discussed in detail about the vast scope of bamboo products. Some of the items displayed on the day were bamboo Vase, Bamboo Music System with USB port (made with a combination of bamboo and coconut shell) and a model of Naam Ghar (Assam) among others. Students were fascinated by the products that can be made with bamboo and interacted with the expert on how to get trained in the craft making. They were told about some of the short courses which are run at regular intervals by the center and the state government and are completely free. The students may enroll in these courses after the regular selection process. A few of the certificate courses among these are also of advanced nature wherein apart from handicraft training furniture and weaving products are also involved.



Dr. Monjeet Sonowal took classes the next two days. He focused on identification of the types of pests. A large group of pests and insects found on bamboo are the same ones found in and on many other crops and plants. Termites one of the commonest insects are easily found at the base of almost all types of plants big or small ones including bamboos. They tend to get into the soil and causes destruction of the shoot and root system. Large numbers of crop protection practices followed in various crops are targeted on preventing pests and insects infestation right from the beginning.



These practices come under the general category of Insects and Pests Management also known in short as IPM. Pest management is an important step which is being taken to prevent losses in crop production. The majority of insects found on bamboo attacks the foliage and culm. They feed on the sap. An ideal method of pest management in bamboo is to go for use

of green manure and mixed agriculture. Growing garlic or turmeric on the fallen shoots of bamboo can prevent growth and infestation of pests and insects in bamboo.



The last few days of the week was fully utilized in the practical on-field training. These sessions were taken by Dr. Rani Jha, Director - Science and Technology, Agricultural Sciences and Skill Development Program Coordinator at the Arunachal University of Studies. First trainees were asked to collect pictures and samples of insects and pests from a nearby clump of bamboo. This was a practical session pertaining to the Insects and Pests Management in Bamboo. The picture of an infested foliage of bamboo below shows, a colony of Rice Mealy Bugs (white ones), Udonga Montana Distant – a seed pest (black ones) and leaf eating caterpillar (black and orange ones) are shown below. All these insects feed on the foliage and sap of bamboo.



Bamboos are also sometimes seen to be infected with fungus in extreme moist atmospheres. A typical picture of the same is shown below. The culm and the leaves both can get infected with the fungi. They reduce the growth of culm and thereby reduction in bamboo farm production.



Bamboo leaves are often used by insects to lay eggs (shown below). The leaf serves as a source of food as well as provides the necessary center for larvae growth. A typical set of cocoons are shown in the picture below.



Flies of various types are commonly found on bamboo laying eggs and feeding on its leaves. One of the common varieties is shown below.



The last day of the training in the week was engaging trainees in the actual plantation of bamboo rhizome, culm and branches. For this, all the trainees were divided into smaller groups. Each group was then given the task of cutting culm into 3-4 node segments.



One segment was then planted by layering technique while the other segment was cut from the top to make an incision of about 1-inch square (culm cutting technique) which was filled with an aqueous boric acid solution (200 mg boric acid in 1 L of water).

Covering the cut with a cellophane tape or cellotape such that the solution does not fall off the newly made incision. This was then planted into the soil. Every group has repeated the process to learn the methodology of bamboo plantation.



It is worthwhile to mention here that already some of the trainees have passed on the information about growing bamboo, the cost benefits associated with it and the methods thereon to their friends and family.



The future of bamboo cultivation can take a major turn if new generation picks up this as their career option.

### **Week-3 [21th – 26th Dec 2020] at AUS, Namsai**

With each passing day of the training program on Propagation and Management of Bamboo, trainees are getting more excited about what more lies ahead of them. While in the first week we had Ex-Professors from Assam Agriculture University coming and teaching the trainees about bamboo, the second week had seen Handicraft expert from Jorhat and Faculties from the Arunachal University of Studies telling trainees how bamboo management can be done effectively and about scope of bamboo small scale industry. This week we had experts from the Rain Forest Research Institute (RFRI) Jorhat, Dr. Rajib Kr. Kalita, Scientist F & Head of Extension Division and Training, and Mr. Kumud Borah, Technical Officer participating in the training as the resource persons.



Dr. Kalita gave an insight on how Bamboo nursery can be established along with its propagation and management. Rhizome is subdivided into monopodial and sympodial types. General growth pattern is from the terminal bud or lateral bud.



Flowering pattern has been majorly studied for bamboo species. In India most of the bamboo flowers anywhere between 35-60 years. Cultivation of bamboo is by seeds (sexual germination), planting rhizome, by cutting branches, culm cutting and tissue culture. Among these, cultivation of bamboo by seeds is less prominent as flowering of bamboo is quite rare and it occurs after several years. Nursery is developed in various sizes depending upon the need of bamboo.



The trainees got a hands-on experience in plucking the branches properly for cultivation. Cutting the branches in the correct size of inter-nodes in between by using proper tools and depth of soil is also shown. Dr. Kalita had brought a few saplings of bamboo along with him on the day which he led the trainees to plant at the AUS agriculture field.



Dr. Kumud Bohra told the students that proper selection of bamboo species for cultivation is very important. Nursery and farms growth is vital but target should be in to maintain natural bamboo forests owing to its numerous other applications.



The second day of the week was focused more on bamboo charcoal. For this Dr. Kalita emphasized that bamboo charcoal can be produced from fresh bamboo, to unused bamboo pieces and also by the residues obtained from bamboo industry. Bamboo charcoal also finds its usage as fuel in common household.



Bamboo charcoal is well known for water purification and to eliminate water impurities and smell. A typical method to obtain bamboo charcoal is burning bamboo in a closed container at around 600-800 degree celcius. The types of kiln used for producing bamboo charcoal is Pit kiln, drum kiln and brick kiln.

Among these brick kiln is the most effective one which produces minimal ash. Bamboo charcoal finds applications is water purification, as cosmetics, air purifier, etc.

The third day of this week was taken care by Dr. Chowlani Manpoong, Assistant Professor at the Arunachal University of Studies, Namsai. He taught the students basics of Agroforestry. Forest Management is of prime importance to conserve and improve the forest site and nearby land resources. A proper combination and growth of trees also ensures right kind of agricultural crops production in the region and proper breeding of animals dependent upon it. The ever depleting forest in the country is a major concern. Bamboos can play a significant role in conserving these depleting forest areas and conserving the natural resources therefore.



On the fourth day of the week, trainees were taken for a field visit to the Bamboo Plywood factory in Namsai under the supervision of Dr. Rani Jha, Director of Science & Technology, Agricultural Sciences and Skill Development Programme Coordinator at the Arunachal University of Studies. The factory was established in the year 1918 by BARD Company (British Establishment). Initially it was established in Assam as timber plywood factory but after the ban by the Supreme Court in the year 1996, it was converted to Bamboo plywood factory and was shifted to Namsai, Arunachal Pradesh.



The factory in-charge of the bamboo board factory showed the trainees how bamboo poles are first cut into small pieces using cross-cutting machine, followed by splitting it into four equal pieces vertically. Knot cutting machine cuts the uneven knots. Flattening machine

1 and 2 and planner machine 1 and 2 makes the bamboo splints. These splints are then arranged between the bamboo plywood obtained from Nagaland in a phase-core-phase style, pressed and made into bamboo boards. The boards are then steam dried followed by sun drying. A coating of resin was put on these boards. Two types of resins are made one commercial consisting of Formalin, caustic soda and urea and the second one is the water-proof resin made with formalin, caustic soda and phenol.



It is worthwhile to mention here that the Plywood factory was once the second largest factory in Asia. Its storage ground is still one of the largest found in the region. Lack of funds has caused the factory to not being able to function to its full capacity. Though the people working in the factory are still hopeful that things would change for better. The facility also showcases bamboo houses which can be screwed in or out when needed and be shifted to a different location within no time.



The last day of the training in the week was once again taken care by Dr. Rani Jha. The class was started by rehearsing a verse from Rig Veda “Bestow upon us a hundred bamboo clumps”. This tells us that our ancient culture has realized the value of bamboo long time back. Bamboo was used as medicine, food and other activities since early ages in the Indian civilization. Where a common timber plant takes more than 20-30 years to mature, bamboo takes just 4-5 years to reach its full height. Some species of bamboo are known to grow 1.5 m/day. Thus bamboo as one of the fastest growing plant of earth, has tremendous potential.



The steep rise in the market of bamboo and its products in recent times is primarily due to the realization of its environmental value among others by the consumers. There has been a constant rise in the demand and therefore supply of bamboo. Still the gap between demand and supply of bamboo raw material is huge and this gap needs to be reduced by development of effective and varied species of bamboo nurseries and farms. A trivia on bamboo has been shown wherein, it was told to the trainees that bamboo filament was used by Edison in manufacturing of the light bulb. Graham bell’s first phonograph needle was made of bamboo. Artificial bamboo teeth have already found a place in dentistry due to its low cost and durable nature. In short, a great opportunity lies ahead for bamboo propagation both by nursery development and by proper farming. The new generation of entrepreneur have to step in to bridge this gap of demand and supply of bamboo now and in near future.

### **Week-4 [28th Dec 2020 – 2nd Jan 2021] at AUS, Namsai**

By the end of third week students have become aware of the vast potential of the bamboo field. The fourth week which was completely taken care by our Senior Resource Person - Dr. Rani Jha, Director of Science & Technology, Agricultural Sciences, Skill Development Program Coordinator, Arunachal University of Studies, therefore focused on commercialization of bamboo and bamboo products. The reasons of how bamboo has lost its value over time and why it has again picked up the importance. Once the fortune of the nation especially in the North-East, bamboo has slowly and steadily started to disappear due to massive deforestation, grazing of animals, growing population and the need for housing. Cutting down trees for everyday use as for fuels, to make furniture, etc. has led to destruction of environment, a reason for the global climate change, a matter of extreme concern.

The week started with a field visit to the Bamboo Cluster at Kakopathar, Assam maintained by Cane and Bamboo Technology Center (CBTC), Guwahati. Dr. Rani Jha, Director of Science & Technology, Agricultural Sciences, Skill Development Program Coordinator, Arunachal University of Studies under her supervision took the trainees to see how the training of the local youths is connected to the propagation and marketing of bamboo products. This place serves as a training ground for the local youths and entrepreneurs. It was a delight to see that the center has hired a lot of handicapped artisans. These artisans are no short of talent when it comes to comparing with the otherwise people. We met a middle aged trainer who was completely handicapped from one of his hands hailing from Namsai, Arunachal Pradesh. He showed us his work on Wooden and bamboo covers for Dao. He also showed us walking sticks made of bamboo with wonderful carvings on its head and neck region.

We met several other trainers who were either handicapped from both the legs or completely deaf, to name a few, but all were doing their training jobs without any visible hindrances. Trainees got impressed and deeply motivated by presence of such artisans especially looking after their work of art. This also proved again that no amount of handicapped nature of body can stop a real determined person to achieve what they want to at any point of age or time.





The week continued with teaching the trainees how to get the bamboo and the bamboo products to the market. What all factors matter the least and the most. How to know which products have the best sale value. Classy products have always more appeal than the regular products be it of wood or of bamboo. Packaging of the products is equally important. Eco-friendly packaging has gained invaluable place lately.

Wine cases made of bamboo are often showcased in corporate parties and business meetings not just in India but also abroad in other countries.



As the training goes by, it is also important to analyze and assess the absorbance capacity of the trainees. This would help us to know which points are needed to be revisited during the future course of the training program. The remaining days of the week was thus utilized in tests, quizzes, one-on-one interaction of trainees with the resource person (Dr. Rani Jha). Trainees were taken back to the road from when they have started the Propagation and Management of Bamboo course. They were asked questions on the basic of existence of bamboo, climatic requirements of bamboo growth, soil quality needed for optimum bamboo cultivation, etc. Various propagation methods and the depth of knowledge in each method of propagation.



It was interesting to see that trainees have not only been able to grasp the immense knowledge shared by the various resource persons but are also inquisitive to the idea of taking up bamboo as a career option. They have found the field valuable, approachable but at the same time are looking at it from an outside the box kind of view. Today's youth is clever not to take the word of mouth but also sits and analyzes it well if the thing said is indeed correct for them or for others.



The various types of kiln used to produce bamboo charcoal which mirrored the conventional stove made and used for centuries in the villages. Bamboo vinegar which finds a lots of other special applications in the market. Use of unwanted bamboo or residues from the bamboo factory for the manufacture of high quality bamboo charcoal. Post-combustion processing of bamboo charcoal using clay in a 3:1 ratio and converting them to briquette of various shapes and sizes. The last day of the week was a seminar day for the trainees. All the trainees were asked to prepare a 15-20 min talk on their journey till date. In the morning, they were all seated in the classroom and asked to make bullet points first. Then breaking each bullet points into sub-points. The most interesting thing in the training program. The most interesting day of the training program. Some trainees were found to be interested in research and development aspects of bamboo. In one of the talks by a trainee, she emphasized on her interest in propagation methodologies for the seed formation. It is worthwhile to mention here that bamboo flowers once after several years and thus production of seeds is also rare. After flowering bamboo plant dies. Tissue culture and Biotechnology can play a major role in assisting to solve these germination and flowering problems. One other student, mentioned that before joining this course he has seen bamboo in his front and backyard but has never

truly understood the utility of it except for just few ones seen around. He also has never thought that bamboo cultivation and/or production of charcoal or bamboo products are such high in demand and can be taken up as a career.

These views and ideas of trainees clearly made the day and the success of the training program is undoubtedly been seen through the eyes of these youths who have become a valuable partner to the Propagation and Management of bamboo training program.

Next week, the trainees will be getting exposed to the wide species of bamboo at the Rain Forest Research Institute, Jorhat during their Field Visit to the institute. They are all excited and have been asking questions about what all to expect from this field trip. Dr. Rani Jha, has already briefed them about the 60+ species of bamboo housed at RFRI, Jorhat. The Tissue Culture labs will be a start to the new dimensions of plant life, a mix of species creation with hybrid properties. Bamboo nursery will be another excitement to look forward to at the RFRI, Jorhat.

### **Week-5 [4th Jan 2020 – 9th Jan 2021] at AUS, Namsai**

Even before this week begun, the trainees have been enthusiastically asking the Resource Person Dr. Rani Jha, Director of Science & Technology, Agricultural Sciences, Skill Development Program Coordinator, Arunachal University of Studies to know how the week is planned for them. They were asking questions on what must be prepared on their part so they can get maximum benefit from the training program. In this week, the entire team consisting of the Program Coordinator cum Resource Person Dr. Rani Jha along with all the trainees have prepared for a trip to the Rain Forest Research Institute (RFRI) at Jorhat, Assam. They all geared up and started the journey early in the morning from Namsai. The trip was enjoyable with trainees singing and dancing on the way to Jorhat. Entering into the city of Sivasagar and then Teok. It is worthwhile to mention that one of our Resource Person for Bamboo Handicraft was from Teok. At this time the Program Coordinator gave instructions to all the trainees about proper way of documentation of the research material they all are going to witness at the Research Institute. Proper sampling techniques are also discussed. Careful observation followed by queries clearance is always a method to understand, learn and remember the concepts. Trainees were encouraged to ask questions at all point of time when asked to do so to any of the scientists they would be meeting at the RFRI Institute.



After reaching the RFRI Institute gate, Mr. Kumud Borah welcomed all the trainees. They were led to their Guest House and after freshening up all had a wonderful meal. Post lunch session, trainees were led to the field trip to the Bamboo World. The RFRI Institute has a collection a 62 species of bamboo, which they have established in Bambusetum. Spread over an area of 1 HA.



Mr. Kumud Borah and Mr. Debojit Neog, Technical Officers at RFRI were the tour instructors. Mr. Deboji told the team about the various types of bamboo in the

Bambusetum. He told the fundamentals of creating this bambusetum. First survey of the various types and species of bamboo is done in the entire north-east. All these species were then collected and planted in the bambusetum area. The species are then screened based on their clump area, culm height, culm thickness, color, leaf size, nodal length, intermodal space, etc. The best species were then taken further for propagation. The trainees got an opportunity to see exotic variety of bamboos as well as normal ones found in the region. Some species were from Vietnam, America, Mexico, etc.



A climber variety of bamboo can be seen in the photograph above. These bamboo are not much of economic value but are more of ornamental uses. They can be grown in low sun areas as well. The study continued with trainees getting to know about the sheath and blade continuity. Ligule is the area connecting the sheath from the blade, sometimes these are attached and sometimes they are merely hanging on to each other. Auricle is the ear shape region on the outside of the joint of sheath and blade.

In some bamboos the auricle is missing entirely.



Usually the age of bamboo is determined by if the sheath is attached to the culm or not. However, in some bamboos the sheath remained stuck to the culm for prolonged age. This also affects the usual color development of bamboo.

*Bambusa balcooa* is a species wherein, the roots are aerial in nature. As can be seen below, roots form a ring around the nodal region with threads of individual roots coming off of each ring.



*Bambusa bambos* is another variety with aerial roots. Another important aspect of classification and identification of bamboo is the way it branches out from the nodal region. The newly formed branches may be bifocal or multifocal. The branching pattern may also be facing up or down.

*Bambusa nutans* is having a zig-zag type of branching pattern. These types of bamboo are commonly found in the jungles of the North-East region on the country.

A typical ornamental cup shaped bamboo species is being depicted below. This bamboo is having very small inner diameter and therefore do not find much economic importance. However, they may be used for the manufacture of handicraft of certain shapes which needed curved outer boundaries.







A rare event in the life of bamboo is flowering. Students got an opportunity to see the bamboo flower from a very close proximity. In the picture here we can see bamboo flower with seeds inside it. It is interesting to note here that most of the bamboo flowers after which they all die. In these instances the flowers give rise to seeds which can be used for sexual germination. However, there are few bamboo species which also flowers but do not produce seeds. Therefore, they survive the flowering season well. They may also flower several times without getting to the end of the plant.



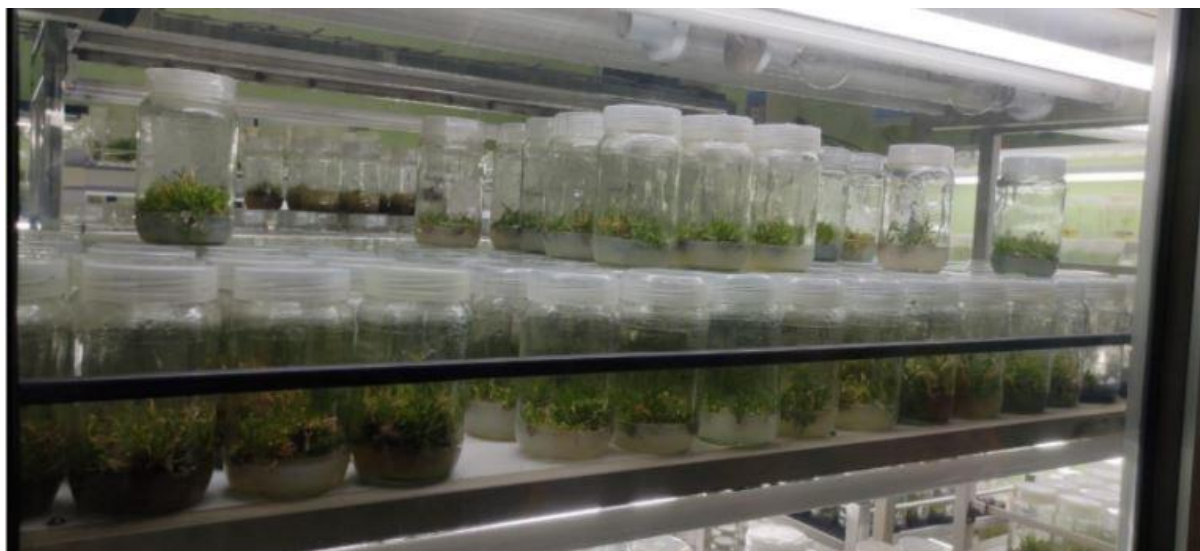
Bamboo nursery is probably one of the most important parts of bamboo species propagation and conservation. At RFRI trainees got to see and experience a wide variety of bamboo species propagation in the nursery. The nursery can be small or large. But its location is very important. The nursery must be located close to the place of use to save on transportation and damage cost. It also should not be located in low-lying areas.



The trainees got hands on experience of how bamboo propagation is done. They all learned modified methods of how branching method and layering methods may be utilized for bamboo propagation. Culm cutting method is probably the more preferred method after seeding for bamboo propagation. Earlier, the trainees have learned to make incision on

bamboo internode to introduce Indole-3-Butyric acid (a plant hormone) or boric acid (a less effective substitute for Indole-3-butyric acid). In here they learned that the injection technique may also be utilized wherein two fine holes are made on the nodal region through which the plant hormone is introduced into the culm using disposable syringe.

Tissue culture is one method by which any plant can be grown from a small part of the plant into numerous plants. Bamboo propagation widely uses tissue culture technique.



Tissue culture lab, managed by Mr. P. B. Goswami, Technical Officer was shown to the team. Culture media is prepared using essential nutrients and a small bamboo branch is placed inside it. After a few month time period the single branch gives rise to multiple branching. Multi-proliferation technique is then utilized to separate out each bamboo shoot and transplanted in the nursery. This method is generally used for the propagation of economically valued species. Also, endangered species of bamboo is grown using the tissue culture method in order to conserve them and simultaneously to propagate them in regions other than its native place. Trainees also got a chance to see the Bamboo composite center managed by Dr. R. D. Borthakur. Here they saw brick kiln which is used for the pyrolysis (burning in the absence of air or oxygen) of Bamboo to produce bamboo charcoal. Bamboo charcoal is then crushed by using a hand grinder and mixed in a 100:25 ratio of bamboo charcoal : adhesive mixture which can be a form of starch like cassava, maida or rice water. They are then hand pressed to form briquettes. One briquette can burn up to 4-5hr. The cost of briquettes is almost 4-6 times that of bamboo charcoal.



Later, Dr. R. S. C. Jayaraj, Director, RFRI gave an overall view of Bamboo research and development work at RFRI. He also interacted with the trainees actively. Trainees asked the Director about the career prospects of bamboo field at and outside of the institute.



During the latter part of the week, trainees got to analyze and assess the knowledge gained at the RFRI institute. They were asked to compare the pictures of various bamboo seen at the institute with the ones found in the nearby vicinity of namsai area.

Trainees took a trip to the various bamboo clumps around the deobeel area. They were able to see bambusa bamboos which is a thorny bamboo variety. This species of bamboo is often

grown in the areas where elephant attacks to the crops are commonly seen. Due to the thorny nature of the bamboo, elephants tend to stay away from these areas and thereby protecting the agricultural crops and wealth of the people.

Dr. Rani Jha, told the students about the concept of horse-shoe type of cultivation and propagation of bamboos. In this pattern, the new shoots grow from the outside of the old culms in the clump. Therefore, the culms on the outside may be harvested for the food. The harvesting of the culms are done from the inside out mechanism so that older culms are cut first for commercial value. It is also important to know here that, bamboo culms of age between 1-2 years are only good for propagation. Whereas, bamboos of age between 3-5 years are generally used for other applications mainly construction due to maximum tensile strength. The shiny nature of bamboo is also found in Jati bamboo to some extent. Trainees documented and have presented their work in the classroom. They have also spoken about the various economical important applications of bamboo and which ones can be truly beneficial in the areas they all belong to. In future each one of them would like to go to their native places and make the farmers aware of how uncultivated lands or the land which is not used anymore for the production of food crops or vegetables can be used for the cultivation of bamboo.

### **Valedictory Session:-**

The valedictory function of a ‘green skill development programme (GSDP) on propagation and management of bamboo’ was held at the [university](#) seminar hall, Arunachal University of Studies Namsai on 23<sup>rd</sup> Jan’ 2021.

The programme was graced by Sh. Kumsi Sidisow Hon’ble MLA and Advisor Deptt. Of Environment & Forests Govt. of Arunachal Pradesh, who along with Chau Zingnu Namchom Hon’ble MLA, 47 Namsai Assembly Constituency (Arunachal Pradesh), VC, AUS Namsai, Director (Environment), Director, RFRI, Jorhat, DFO Namsai, Asst. Director Skill Development, GoAP, Namsai etc.

During the function, the participants were felicitated and certificates of completion of the training programme were awarded to them.

**Photo Gallery Valedictory Session:-**



***Group Photo with trainees***



***Distribution of Certificate to Trainees by Hon'ble MLA cum Advisor to Minister (Env& Forests) Shri. Kumsi Sidisow***



***Address by VC, AUS Namsai***



***Address by trainees expressing his satisfaction and positive feedback for the GSDP Training***



***Distribution of Certificate to Trainees by Chau Zingnu Namchoom Hon'ble MLA, 47 Namsai Assembly Constituency (Arunachal Pradesh)***





