



Internship at Uravu

Wayanad

Final Report

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This is to certify that Mr.Issac Junior ,MDes Product Design, Industrial Design Centre IIT Bombay has done his Summer Internship for a period of one month (from 12th of May till 13th of June) and has assisted in the following projects/fields:

1. Solar Workstation
2. Redesign of Bamboo Pen
3. Accessories
4. Furniture design

Mr. Issac Junior has been found to be keen in conceptual and technological explorations and their respective mock-ups and has succeeded in formulating new ideas and concepts. His conduct has been good throughout the internship period and we wish him all the success for his future endeavors.

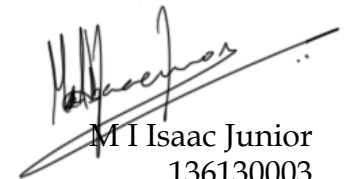


For URUVU
President

Completion Certificate

Disclaimer

The content produced in the project report is an original piece of work and takes due acknowledgement of referred content, wherever applicable. The thoughts expressed here in remain the responsibility of the undersigned author and have no bearing on or does not represent those of Industrial Design Centre, IIT-Bombay.



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Lastly, I would like to thank my parents and my classmates, especially Gautham R Varma, Anulal V S and Manu Revi for providing me with mental support and discussing my work from time to time.

I am grateful to all those people who wished me well and helped me make my days at Uravu most memorable one.



Abstract

A month of internship under Uravu Indigenous Science and Technology Study Centre in Thrikkaipetta, Wayanad district, Kerala that helped in better understanding bamboo as a material that aids in the development of a village by facilitating craft. Observed different events including cultivating, processing and using bamboo for producing a range of utilitarian and artistic bamboo products.

Visited different micro industries supported by Uravu and noticed the functioning of craft trade system followed by them. Became part of the village by celebrating World Environment Day and visited the upcoming EcoLinks project by Uravu. Analysed few of the design challenges faced at Uravu and also attempted to create a utilitarian product out of bamboo.

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On an emotional note, Wayanad has always been welcoming - the ghats, forests and simple lifestyle of people always pulls you back to the place. Boasting rich history and virgin forests, Wayanad captures ones attention and never fails to leave a lasting memory that always urges you to visit again

Uravu: An introduction

Wayanad

Wayanad is one of the fourteen districts in Kerala, situated about three hours from Calicut which is the nearest city. Wayanad has its headquarters in Kalpetta. It is also the least populated district in Kerala. It is set high on the Western Ghats with altitudes ranging from 700 to 2100m.

About Uravu

‘Uravu’, an Indigenous Science & Technology Study Centresituated on the Western ghats in Kerala (Thrikkaipetta village, Wayanad district) among the misty mountain range and lush green backdrop, is an organization of international recognition acclaimed for promoting the cultivation, development and means to earn livelihood through the sustainable gift called Bamboo.

A non-government organization, currently focused on bamboo-centered products and services, believes in sustainability in every aspect its involved with. Uravu implements integrated, end-to-end programs in the bamboo sector, which include providing skill training in bamboo processing, establishing micro enterprises, marketing of bamboo handicraft, cultivation of bamboo and promotion of eco-tourism.

How to get there

Uravu is situated at Thrikkaipetta village in Kalpetta jurisdiction of Wayanad district, Kerala. If coming from Kalpetta towards Meenangadi along the Kozhikode-Mysore-Kollegal highway i.e. NH 212, to reach the NGO, one must take a right turn at Muttill town. Approximately after 5 -6 km we reach Thrikkaipetta village, after passing through Mandad town. Once you are in the village you could ask for directions or keep an eye out for the small signage to the left side of the road. Refer to Fig 1 showing directions to Uravu from nearest city Kozhikode.

Public transport buses are available from Kalpetta to Uravu, but they are less frequent. The nearest airport is Karipur International airport which is two hours of drive from Kozhikode. Kozhikode is the nearest city situated at two hours of drive from Kalpetta. Nearest railway station also happen to be at Kozhikode as the ghat sections of Wayanad is still not connected via rail.

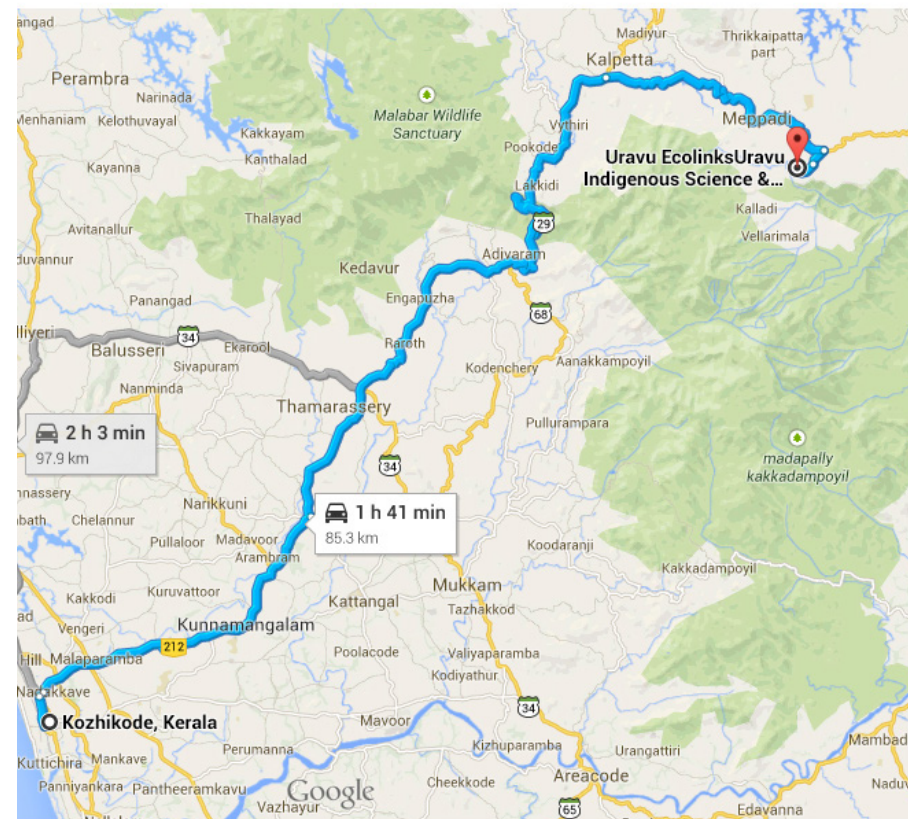


Fig.1: Map depicting transit to nearest city, Kozhikode

Visions: The Path Ahead



Fig.2: Entrance to Uravu Crafts Centre

Upon discussions with Mr. Baburaj, a patron of Uravu, a brief idea was obtained regarding the path in which the NGO has to move forward if it is to sustain itself. Rather than becoming a hub for needs, Uravu should grow into being a torchbearer. Fig 2 shows the entrance to craft centre, a two storeyed building encompassing administration and all craft related activities

- Uravu should rise up to the level of a knowledge and research centre in true essence.
- A place which looks into different other sectors including research and exploring other potential ventures/ opportunities along with imparting training and guidance to micro units.
- The future of the current existing system looks bleak as Uravu currently is burdened with cumulative losses of the different units working under it.
- Units or people should own up to what they produce and take up responsibility for themselves.
- The necessary guidance and support can be provided by Uravu but Uravu cannot be asked to sustain the units for a long period.

- After an initial period, Uravu should be able to pull out and let the unit run for itself.
- Currently its not possible as there exist a lethargic and non-ambitious attitude of people working under most of the units.
- Furniture segment is planning a comeback through designing a table, that does not merely serve the purpose of a table, but also aims at providing an income to the people who own them.
- Thats where the concept of bamboo table powered with solar energy comes into place.
- It aims at taking the production capacity a level deeper to household production units, in which people can work during their flexible timings to create craftwork/products of commercial value depending upon their skill and taste
- Such a system [Solar Workstation] helps reduce the power dependancy and legal formalities associated with starting a production unit.
- The solar workstation aims at creating a DIY unit that promotes widespread movement of individual creation and hence should be knock down assembly, transportable and efficient in design.



Fig.3: Cut bamboo and bamboo slivers

Uravu Craft Centre

The craft centre that acts as the hub where the final touches are done for all products. It contains product display shop showcasing various commercial products of Uravu. The business administration and market related activities of craft products are also executed here.

The design studio of Uravu explores different properties of bamboo and utilise them to create installations and form explorations that can be converted to feasible products in a later stage. Design studio is handled by Mr. Lenin and his assistants. Art expo for installations and other one-off products are conducted across India under him.

Craft centre provides raw materials and design guidelines to the units associated with it and the units produce goods according to requirement. The processing of raw bamboo is done here as shown in Fig 3. These are then given back to Uravu where final touches are done and the product is marketed.

Understanding Bamboo

Bamboo, essentially, is a grass. It is one of the fastest growing plants and its vertical growth depends on the geographical locations. In the Mediterranean regions bamboo grows only to a limited height of about 1-1.5 feet, whereas, in the equatorial regions, they would grow to its full potential, up to height of about 20-25 feet.

There exist more than 1250 varieties of bamboo across the world, out of which 136 are identified in India and 28 among them in Kerala.

Growth Pattern

During the early stages, the growth is less and is more confined beneath the ground at root level. From the middle of second year, shoots start coming out and roots propagate beneath the ground. In the subsequent years, more and more shoots sprout up. By fourth and fifth year onwards harvesting of the matured bamboo begins, which can be continued from then on. Patterns start showing on the bamboo once its matured enough to be harvested. To make it easier for the on-site workers, colour coding is done, with respect to each year, to the shoots that come up.

Upon visiting the Bamboo Nursery at Uravu the different facts , classifications , growing techniques, industrial/craft uses and behaviour of Bamboo was explained by Mr. Radhakrishnan and Mr. Baburaj. A total of 3 days was spent on .understanding Bamboo as a plant

Methods to identify different types of Bamboo

Natural methods for identifying different types of bamboo are:

- By observing the development of the Sheath
- The forms and patterns on the leaves

Growth patterns in Bamboo

Monopodial - Bamboo grows individually, where different shoots sprout at a certain distance from each other.

Sympodial - Bamboo grows as a bunch and shoots sprout close to each other

Bamboo varieties for construction purposes

Guadua augustifolia - Fig 4

- A bamboo variety from Columbia
- Monopodial
- Non- Bendable
- Diameter same for first 15m and then tapers to top
- One thorn at a node
- Used singularly or can be bolted together, as per need
- Lifespan of about 70 years
- 15% more BTU than other fuel woods (alternative fuel)



Fig.4: *Guadua augustifolia*

Bambusa bambos - Fig 5

- Native of Kerala Ghats
- Sympodial- difficult to harvest
- Structural strength- almost double as of Guadua
- Thorny bamboo
- Pruning technique while growing- for easy harvesting
- Pruning - if not done, results in wastage of immature bamboo as the whole bunch is harvested



Fig.5: *Bambusa bambos*

Dendrocalamus strictus - Fig 6

- A tropical genus; similar to Bambusa genus
- Best for cantilever structures
- Attains a height of 30ft
- Also used in furniture
- Variants exist within Kerala, in different districts
- Comparatively thin cross section of 3-4cm

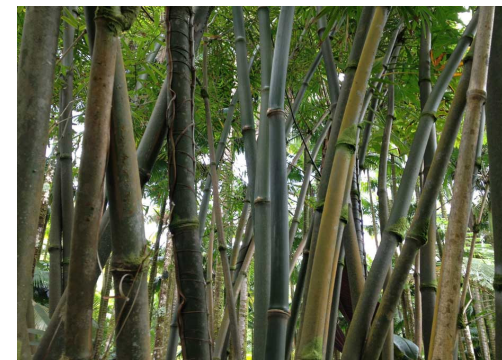


Fig.6: *Dendrocalamus strictus*

Dendrocalamus brandisii - Fig 7

- Native of Southeast Asia- wet evergreen tropical forests
- Also known as velvet leaf bamboo
- Lifespan of 60 years
- Thornless
- Sympodial, but less branches- hence easy to harvest
- Used for pillars and roofing
- Also used in handicrafts



Fig.7: *Dendrocalamus brandisii*



Fig.8: *Dendrocalamus giganteus*



Fig.9: *Bambusa balcooa*



Fig.10: *Bambusa nutans*

Dendrocalamus giganteus - Fig 8

- World's thickest bamboo but not the strongest
- Will reach heights up to 46m
- Pillars can be made out by splitting this bamboo and filling concrete within
- Lifespan of 100 years

Bambusa balcooa - Fig 9

- Indian origin
- Strongest, thorn less
- Called a semi solid bamboo as the cavity within is comparatively small
- Inner wall thickness of 4-6 cm

Bambusa nutans - Fig 10

- Grows at altitudes between 500-1500m
- Thrives on moist hill slopes and flat uplands
- Commonly found in the North East, Orissa and Bengal
- Thorn less
- Strong bamboo used for scaffolding
- Sympodial growth, but still can be cut out individually with skill
- Used for creating ladder, pillars etc

Schizostachyum dullooa - Fig 11

- Grows up to an altitude of 1200 m
- Found in the North-eastern region of India
- Thorn less
- Sympodial
- Thin cross section
- Grows straight without bends
- 30 ft in height
- Comparatively less strong



Fig.11: *Schizostachyum dullooa*

Rostretta - Fig 12

- 25 ft in height
- 3-4 cm wide cross section
- Used in furniture making too
- Easy to harvest
- Interior hole is comparatively small



Fig.12: *Rostretta*

Dendrocalamus sikkimensis - Fig 13

- Similar to Brandisii but shorter and thinner
- 40 ft in height
- Branches are normally orange in colour
- Used in pillars as strength is more
- Immature ones used in weaving too

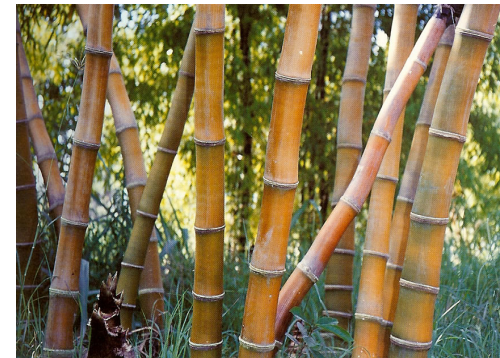


Fig.13: *Dendrocalamus sikkimensis*



Fig.14: *Burmese bamboo*

Burmese bamboo - Fig 14

- Just below *Dendrocalamus giganteus* in height, width and strength
- Used in pillars

Siamensis - Flg 15

- No hole inside
- Bendable
- Used more in furniture
- 20 ft in height
- Bends sideways while growing



Fig.15: *Siamensis*

Melocanna baccifera - Fig 16

- 25 ft in height
- Grows in tropical region
- Monopodial - one metre between successive shoots
- Thorn less
- 3-4 cm wide

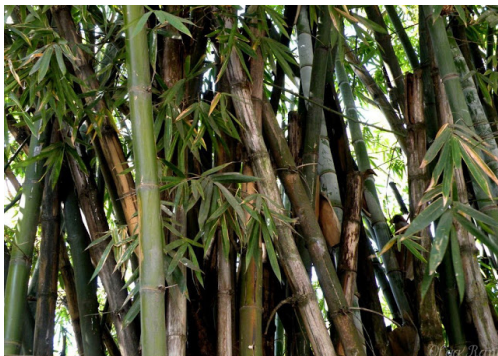


Fig.16: *Melocanna baccifera*

Dendrocalamus longispatus

- Glaucous green when young, grayish-green on maturity
- Grows straight
- Distribution: Thailand, Malaysia, Bangladesh and India
- Thorn less: good for construction
- Requires shade to grow
- Grows up to 50ft in height and 1.5 to 2 inch wide

Thyrsostachys oliveri - Fig 17

- Distribution: Thailand, China, India
- Needs less space to grow
- Thick sympodial
- Tough to harvest
- 2-3 cm width

Unidentified Species - yet to be realized with help of bamboo corp

- Soft and lush green
- Thickness of 3-4 cm
- Has lots of branches
- Big hole inside
- Hollow, but used in roofing

Bambusa Tulda - Fig 18

- Similar to balcoa
- Medium diameter hole inside
- Branches at base
- Sympodial

Pseudoxytenanthera ritchii

- No hole and bendable
- 2-3 cm wide and 20 ft height
- Suitable for furniture



Fig.17: *Thyrsostachys oliveri*



Fig.18: *Bambusa Tulda*



Fig.19: *Palida*



Fig.20: *Dendrocalamus membranaceus*



Fig.21: *Buddha bamboo*

Palida - Fig 19

- Grows straight
- 2 inch wide and big interior hole

Dendrocalamus membranaceus - Fig 20

- Used for construction
- Grows up to 60ft tall
- Bigger hole more than 2 inch
- Used for making ladders

Dendrocalamus Asper

- Native to Southeast Asia
- Used for heavy construction
- Shoots are consumable

Bamboo Used for Ornamentation

- Buddha bamboo (*Bambusa Vulgaris Wamin*) - Fig 21
- *Bambusa multiplex*
- Bush Bamboo
- Golden Bamboo
- Creeper Bamboo
- *Bambusa multiplex vangata*
- Chinese Bamboo (*Phyllostachis Bambusoides*)
- *Bambusa vulgaris*- Green
- *Bambusa vulgaris*- Yellow
- Black Bamboo - Fig 22

Bamboos Used for weaving

- Ochalndra Travancorica
- Ochalndra Scriptorla
Used for making pens and jewellery
- Schisostachium Bedomi

Cultivation techniques at Uravu

- Growing seeds
- Hormonal Process

A small hole is made on a bamboo stem. A mix containing 7gm Naphthalic acid, 100ml alcohol and 900ml water is made. This mix is added to 9L water and poured inside the bamboo through the hole till brim. Then it is wrapped up with plastic and buried in ground. Shade is provided. New bamboo shoots grow from the nodes.

- Replanting from a bunch after taking one plant (with root and shoot) out.



Fig.22: Black bamboo

Unit visits



Fig.23: Bamboo vessel at Niravu



Fig.24: Rainmaker at Niravu

As part of getting familiarised and understanding the different stakeholders associated with Uravu a visit was done to the different units that work under / obtain guidance from Uravu. The micro enterprise units were established under the Rashtriya Sam Vikas Yojana (RSVY) programme, providing employment in bamboo craft to rural people.

The visit encompassed Bhavm Mural Arts, Niravu, Soubhagya and Unarvu. These units laid out pictures of achievement, struggle, stagnation and hopes that people live with as they continue to be part of the craft industry in Kerala. These following are the short glimpses into the lives of many who help constitute the fragile craft sector in and around Uravu.

Niravu

A self-help group run by women, Niravu has been creating variety of craft products such a The Rainmaker[Fig 24], phone stands, vessels[Fig 23] etc. for more than nine years. The products created are as per the requirement / orders which are delegated from Uravu. Employees at Niravu receive their income based on

the number of products that they deliver to Uravu. The unit is still not self-sustained even after being in operation for a decade. Even though there are opportunities for them to attract craft orders on their own, such a potential has not been realized and they still depend heavily on Uravu.

Bhavam Mural Arts

This unit showcased a successful story of creating a steady market for craft products. The unit focuses on mural art works[Fig 25]. *Dendrocalamus Gigantus* variety of bamboo is used to create mural paintings. Bhavam[Fig 26] are no longer under Uravu, and require assistance only regarding raw material and guidance. The mural paintings from Bhavam were done on walls, canvas, and on all things that had utilitarian value. They progressed in a way where they utilized the technical knowledge about bamboo along with their creativity to create a niche sustainable market that nourishes craft and creativity.

Soubhagya

Another self-help group run by women, situated in Parathode renowned for making Book of Spices[Fig 27, 28]. The unit has adequate machinery in terms of sander, grinder etc. The workers are paid a fixed salary per month. Their output is also based on the orders delegated from Uravu. Training for the workers are imparted from Uravu and their working hours are from 9am to 5 pm every day. The transporting of products / raw materials in between Uravu and Soubhagya are through public transport buses or via hired goods vehicle.



Fig.25: Mural art on bamboo at Bhavam



Fig.26: Bhavam Mural Arts outlet



Fig.27: Book of Spices at Soubhagya



Fig.28: Book of Spices at Soubhagya

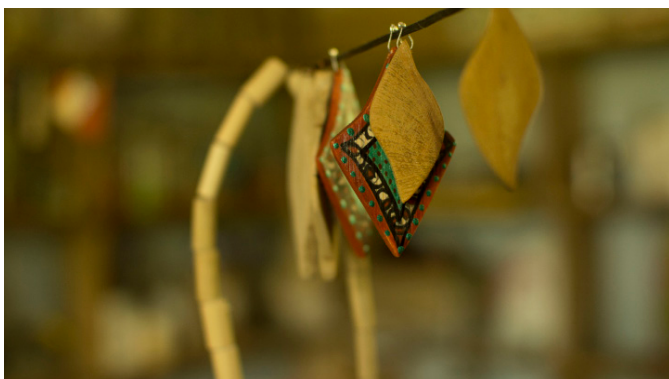


Fig.29: Bamboo jewellery at Unarvu



Fig.30: Bamboo accessories at Unarvu

Self-sustainability has not been achieved by the unit even after being operational for about 5-7 years. Soubhagya is still heavily dependent on Uravu. They still have not attained the level to ensure quality check and to manufacture totally finished final products. Semi-finished goods are transported back to Uravu for the final steps and quality check. The members have the skill to work with bamboo, but are not able to explore additional products owing to the lack of time. Most of the members are housewives and mothers.

Unarvu

Another self-help group run by women situated in Moorikkappu, Vengappally. Unarvu showcases a story in which the bamboo craft training imparted to them were put to use in accessory design, creating earrings, necklaces and other jewellery for women[Fig 29,30]. They faced difficulties to own a working space and hence registered their self-help group as a society and built a space using a loan. They devised a strategy of employing only married and settled down women who belong to the nearby villages, thus ensuring that there were no fallouts once the members were trained.

After breaking even to a certain extent, they even started to source raw material on their own without the assistance from Uravu. They use minimal machinery for the production. Students and Interns specializing in accessory design provide their valuable input in jewellery design. Unarvu is also active in conducting exhibitions across India.

Bamboo as a material

Bamboo in the pure and natural form is less resistant to the biological degrading organisms. The large amount of starch content present in bamboo attracts the degrading organisms like fungi, termites, and becomes the food for these organisms which are generally called Borers. The average natural durability of bamboo is less than 2 years. However if stored with care, the untreated bamboo may last up-to 4-7 years that too very rare. Bamboo is also known to be rich in silica, but the entire silica content is present in the outer layer. Even though it has minor amount of waxes, resins and tannins, but none of these have enough toxicity to improve its natural durability.

Compared to timber, bamboo has a low natural durability, hence few chemical treatment methods are used to improve the durability of the bamboo columns. The treated bamboo are completely safe from the borers and the durability increases many folds. Different varieties of Bamboo are grown in Uravu showcasing growth patterns[Fig 31,32]



Fig.31: Bamboo cultivation at Uravu



Fig.32: Bamboo thorns



Fig.33: Gas pressure impregnation



Fig.34: Hot dipping - immersed bamboo



Fig.35: Hot dipping - retrieving treated bamboo

Bamboo Treatments used in Uravu

1. Gas pressure impregnation

The bamboo columns are placed in a pressure chamber and the air inside the chamber is sucked out[Fig 33]. With the help of a vacuum pump, the chamber is then pressurised with vacuum. The chamber then slowly filled with the treatment chemical (Borax and boric acid powder) and pressure is applied to a predefined value of 16kg/cm^2 . Due to this pressure the chemical gets pushed into even the small pores in the bamboo and the entire bamboo column gets soaked in chemical. For a 100 litre of water , 3 kg of boric acid powder and 2.5 kg of borax is used as the chemical . The entire pressurised chamber is kept untouched for a day and the columns are removed from the chamber the next day. The treated bamboo's are then dried, and used for further manufacturing processes.

2. Hot dipping

The fresh cut branchless column with punctured nodal walls are weighed down and boiled in a container with chemical solution (Boric and Borax powder)[Fig 34, 35]. The minimum process time is 4 hours. The treatment is done for splitter and small diameter bamboo in small quantity.

World Environment Day

June 5th is World Environment Day. As a patron of green movements, the environment day was well celebrated at Uravu[Fig 36]. A gathering was called for, to remind and remember the ecological imbalance faced by earth at present and how we, as humans, are responsible to change or rather slow down its course as it has reached an extent where it seems the catastrophes are irreversible.

It was also said that, at Uravu, Environment day is not just for a day. It is a social responsibility every human has to carry with him through out his life for the sake of the planet and for the sake of the future generation.

The Environment day was celebrated in the nearby schools also. There were rallies by the students pledging themselves to be a part of this social cause. Bamboo shoots were planted at Uravu as well as in the school.

There was also a performance by a student trainee, Mr. Vibhu, who made beautiful musical instruments with bamboo.



Fig.36: Bamboo distribution on World Environment day

Uravu Ecolinks



Fig.37: Bamboo house at Uravu ecolinks



Fig.38: Wall construction using chicken mesh & bamboo

Uravu has come up with novel solutions to housing problem at wayanad, especially how to tackle uneven terrain in a sustainable way. We had a chance to visit the housing project and to understand how this is undertaken[Fig 37].

The main structure rest over a base made of palm pillars containing concrete. Main structure that houses the bedroom is has wall made out of mud plaster (mud+sand+lime+1-2% cement) on the inside as this does not come into contact with water and the outside wall is lined with bamboo strips[Fig 38] (*Dendrocalamus Giganteus*). Each structure has an attached bathroom which is lined using ferrocement due to the constant exposure to water. Interesting part of eco links structure is its butterfly roof, the 2 flaps of which are held together by ropes to prevent it from transferring excess weight to the pillars. The roofs are lined by 2 layers of bamboo[Fig 39] (*Dendrocalamus brandisii*) mats, chicken mesh and 2 layers of ferrocement. Bambusa bamboo forms the pillar structure[Fig 40], while *Dendrocalamus brandisii* is used for beams.

A single kitchen is built to service the whole housing structures which are solar powered and sensor lightings are provided in the pathways to reduce power consumption. Water management is

one issue when it comes to housing and the way its managed is what makes eco links stand out of the rest. Water from reservoir is fed into a fresh water tank, which goes directly into shower, wash basin and kitchen. This water is then fed into a grey water treatment tank and then to grey water tank. This treated water is fed into the flush system which is again send for water treatment and finally into the landscape. This process ensures safety of ground water at the same time ensuring proper water supply to respective areas.



Fig.39: Roofing at Ecolinks



Fig.40: Palm and concrete base for construction

Book of spices

About the book

The Book of Spices[Fig 41] is a unique product made in the Uravu Kalpetta Bamboo Cluster, which has won much appreciation on account of the perfect match of innovative concept and utility value as a gift product. The Book is basically a box in the form of a book that can hold samples of spices (and for that matter many other items such as dry fruits, chocolate etc.) and be sold as a gift/memento. Uravu has been using the Book filled with organic spices as a memento of Wayanad.

The present form of the Book comprises of front and back covers made of bamboo veneer board (8.25 X 5.25 inch) size. The inner portion of the back cover holds a rectangular frame made of giant bamboo reapers of 6 mm thickness which functions as the box. There are partitions(4 to 9) in the box made of thin strips of bamboo, which acts as a container for spices.



Fig.41: Book of spices. Exterior and Interior

How is it made

Earlier Uravu was making the book covers by joining and gluing together 4 strips of giant bamboo longitudinally, using fevicol. The glued planks are then pressed but keeping stones on top.

Issue faced with current design

Under hot and cold climates in India as well as abroad, the strips displayed a tendency to gradually bend or warp. This appears mainly do to presence of moisture in the bamboo due to non uniform drying process[Fig 42].

Methods tried so far

- - A cross-stitch with thinner bamboo strips were placed on the inner side of the front cover, taking out a groove on the board and inserting a strip of bamboo. This could not prevent warping to the required extend.
- A certain type of Bamboo Veneer boards (4 mm thick altogether with 0.5mm bamboo veneer sheets pasted on both sides of a 3 mm wooden ply board) were used. Scarcity and weightage period to procure the raw material made it a difficult choice of replacement, even though it helped in mitigating the problem to a certain extend.
- Hand-made slivers of *D. giganteus* (around 0.5 mm- 1 mm thickness) were pasted on both sides of a mechanically hot-



Fig.42: Warpage or Bending of bamboo

pressed industrial board (of 3 mm thickness). The process involved taking slivers of uniform thickness which were glued uniformly on both sides of the board followed by application of uniform pressure on the board to fasten the slivers without air blotches. Even though this could prevent warping, Uravu faced the following issues in this regard:

- Hand slivering combined with rotary sanders had to be used as machines were not able to provide the required uniform thickness (0.5 - 1 mm). This required proper training and skilled labour.
- Glues had to be applied in a uniform manner which required proper training and skilled labour.
- Lack of hot press system.

Solutions suggested to prevent warping

1. Redesigning book of spice

After a brainstorming session, suggestions were put to redesign the book of spices. It was observed that warping was localized to only the front side, as the back side had its strength coming from the box like wood structure attached to it. Question was, why not bring in a similar structure to the opening flap where warping is observed. To an extent this could solve the problem, but at the same time gave rise to some issues like :

- Training artisans to the new designs
- The whole philosophy of opening a book to its starting page becomes non existent.
- Need for extra raw materials.

- Cuts had to be more precise due to existence of male and female pieces locking together.

These issues led us into leaving behind the idea of redesigning book of spices and we started looking for new solutions to counter warping.

2. Into the world of adhesive

Absence of a hot press and cold press being the only choice, made us look into various options when it came to the choice of adhesive while laying out bamboo strips. We approached various organizations having prior experience in bamboo ply, one among which was Bamboo Corporation, Nallalam and got insights into adhesives like Starke D3, Blue coat D3 and Henkel food grade which could be directly used. They also suggested using Urea Formaldehyde combined with Ammonium Chloride catalyst. As most of the above adhesives could not be locally procured, we contacted the local manufacturer of urea formaldehyde - Poly Formalin Pvt Ltd and paid a visit at their factory to arrange for test samples as well as to understand ways of adhesive application. Following actions were suggested to prevent warping :

- Using 65% Urea Formaldehyde resin with catalyst formic acid(both of which could be locally procured)
- Mixing clay powder or starch with the adhesive to enhance bonding.
- Bamboo strips should be placed in a cross fashion to counter warping.
- Application of adhesive should not be too much or too less, preferably one layer of uniform thickness.
- Application of uniform pressure over the planks.

Bamboo Pen



Fig.43: Unfinished bamboo pens

Upon visiting Uravu and gaining an understanding of the various craft products that were marketed, the attention was channelled towards the manufacturing of Bamboo pen [Fig 43] – a flagship product of Uravu that is sold across different markets. The design of the pen has not evolved from its inception. Upon interacting and observing couple of craftswomen who were dedicated to the process of manufacturing pen the following observations were concluded.

Work area description - Bamboo pen

The work area designated for the production of bamboo pens had the following infrastructure available for two craftsmen

- Table[Fig 44]
- Coconut shell
- Bamboo shoots
- Super Glue
- Knife

- Mini saw
- Box of refill
- Sand paper
- Bamboo holder
- Nails for support
- Stool
- Sander
- Drill machine

Activity analysis of Bamboo Pen

1. Making of nib

- Choose bamboo pipe of approximate diameter.
- Check the diameter of the hole by inserting a bamboo stick of pre calculated width (to insert the refill)[Fig 45].
- Cut the required length of bamboo depending on the neck of refill.
- File the cross section to smoothen and flatten the surface.
- Making of the tip of the nib body out of coconut shell.
- Coconut shell is selected based on its thickness and mature state.
- Holes are drilled up on to the coconut shell using a drill bit selected according to the size of roller ball refill.
- A square section is cut out of around the hole using a mini saw and the working table acts a support during this process.
- These sections are filed to make the surface smooth.



Fig.44: Work table



Fig.45: Testing snug fit

- The section is now stuck to the broader portion of nib piece using super glue.



Fig.46: Body of bamboo pen

2. Making of the top half (upper barrel)

- Pen nib portion is pressed on to the bamboo piece selected for the upper barrel of the pen.
- The above steps are repeated to make multiple bodies (4 - 5)
- Sanding of the top portion[Fig 49]
- Top portion with nib piece stuck on to it is sanded and made to conical shape.
- This is continued for all the 4 or 5 pieces.

3. Making of the cap

- Drilling the bamboo along the length using a drill bit to make it hollow.
- 2 drill bits are used during this process. First, a drill bit of smaller radius to prevent breaking of bamboo during the process, followed by the drill bit of correct radius.

4. Making the protective ring of the cap

- Coconut shell is drilled of the same radius as that of the cap and is sanded on both sides using a sander to make it smooth for later sticking.
- Square section cut around the hole and stuck to the cap.
- Cap is cut according to the required size[Fig 47].



Fig.47: Gauge for measuring cross section

5. Cutting out the top half to accommodate cap

- A cut is made on the conical top half part using a rotating marker blade, depending on the length of the cap.
- A mini saw is used to make the mark more pronounced.
- Scales are cut out from the bamboo from the marked portion and then filed to make it snug fit to the cap[Fig 48].

6. Making of the bottom portion (lower barrel))

- Hole in the bamboo is checked as to whether it can house the refill using a bamboo rod.
- This is cut and kept in the pipe according to the length of the refill.
- The bottom is again closed by keeping a cut out and smoothed square section at the base of the pen[Fig 46].

7. Finishing to get the final shape.

- The extruded portion of coconut shell is sanded to the profile of the bamboo.
- Scales are removed along with this using the sander.
- All the pen bodies (4 to 5) are done at the same time.



Fig.48: Cutting the snug fit part



Fig.49: Sanding for finish near grip area

8. Making of the clip

- Clip shape is cut out from a bamboo stick and length is checked with the cap.
- The cut out structure is filed to flatten and smoothen it.
- The contact surface is cut to the curvature of the cap and checked frequently for alignment.
- The clip is then stuck using fevikwik and the scales are removed using knife.
- The surface is smoothened using a sandpaper in the outside as well as inside.

9. Polishing the pen

- The pen is polished post the making to avoid stain and prevent it from bugs.

Problems Identified

- Crowded and wobbly worktable.
- Absence of protective gear
- Lack of measurement guides to ensure accuracy
- Drilling process resulting in excess heating of bamboo.
- Stains in the sanded portion can lead to discarding the product. Is there any way to reuse it?
- Less number of skilled workers resulting in reduced productivity
- Most workers prefer hand work rather than machine.

Problems identified in pen design

- Cap is snug fit rather than locking.
- Refilling the pen appears to be a hectic task.
- Outdated design.
- Absence of transparency in the material may make it difficult for the user to identify when to change the refill.
- Absence of screw fit in most cases, craftsman relies on either snug fit or adhesive.

Design Considerations

One of the major considerations regarding the bamboo pen sector is the production capacity of the pens. There had been times when pens made of bamboo were not produced in the required quantity as requested by the client. The thoughts that went in while trying to create a bamboo pen were:-

- Simplify the manufacturing process
- Remove the dependency of choosing/selecting right bamboo according to dimensions
- Increased production
- Use and throw pens as the carbon footprint of these ought to be lower than conventional plastic use and throw pens
- Easier to hold and use – the current pens are bit bulkier and doesn't fit perfectly within the three fingers
- Reduce dependency of skilled labour in producing pens
- Reduce the time required in creating a pen

Prototype Iterations

1. First attempt

Initial attempt was done by using the method of coiling bamboo strips. A cylindrical metal rod was taken as the mould and bamboo strips were wound around it and stuck together using a quick adhesive. The form of a pen was brought out, which could contain a jotter / regular refill and the tip of the pen was strengthened using a piece of coconut shell.

But the coiled structure of pen was not able to withstand force applied perpendicular to the length of the body resulting in breakage. The process of coiling strips with precision required the assistance of skilled craftsmen and it also required considerable amount of time to be spent on making a piece.

2. Second attempt

The second iteration aimed towards creating a refillable jotter pen in which the refill could be replaced once the ink runs out[Fig 50]. A metallic spring was the only foreign material used in the iteration. The proportion of the pen became a bit bulkier and it was figured out that creating the intricate parts in bamboo was indeed a challenge. The open able part of the pen was created using a strip of rubber grip found in pens that has considerable elasticity and accepts certain amount of fatigue.

Even in this iteration the problems of bigger proportions, requirement of skilled labour, time investment per piece and creating intricate details popped up.

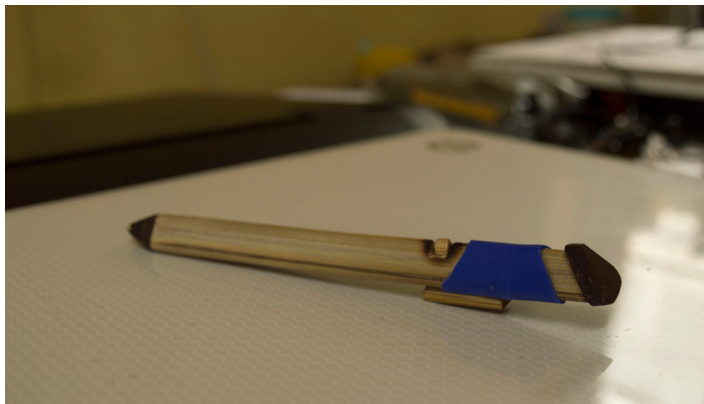


Fig.50: Second attempt

3. Third attempt

The third and last iteration aimed at creating a pen that could be conceived with minimal time investment and focusing on a simple process that would ease the production process which doesn't require skilled craftsmen. The cross section of the pen was made triangular which made it easier to hold between the fingers. The manufacturing process removed the constraint of selecting the right bamboo with prefixed cross-section dimension and the pen could be created using three flat / curved bamboo sections cut to the required length[Fig 51].

This method helped in creating a pen which could be easily produced by unskilled labour. The time required for creating a piece was considerably low. Bamboo pens created using the triangular cross section form language were found to be quick and easy to make and thereby could be used as use and throw pens with minimum effect on the environment.

Manufacturing Process

- The required bamboo is selected and is cut to the required length
- Then the bamboo is split into three / more semi - curved flat pieces
- Three pieces are joined together to form a triangular cross section using strong adhesive
- Sufficient central cavity is provided to keep the required re-fill



Fig.51: Third attempt

- Tip of the pen is hardened by joining a piece of coconut shell
- Rear end is sealed with another piece of coconut shell
- A small hole is drilled on the pen body to help ink flow downwards

Challenges faced

- Designing a cap for the use and throw pen
- The cap requires exact snug fit dimensions according to the pen it fits into
- Thus cap making became a time consuming process in manufacturing one piece
- Sanding the tip of the pen near the grip region requires precision and considerable time

Bamboo Building Blocks

Spatial talent of the students is a facet that has not been appreciated to the full extent during the early years of education. Scientists who explore about the learning capacity of children have brought out the observation that spatially talented people are often less verbally fluent and are unlikely to be very vocal.

This observation led to the question whether the common notion of quiet and 'inactive' children being classified as 'less bright' was acceptable or not. Allowing kids to deeply engage with a project they are passionate about helps produce more positive memories of school. As building blocks have proved to be a toy of common interest among vast scores of children an attempt was made in creating one using bamboo[Fig 52, 53].

Design Brief

To create the B3 toy

- Completely done in Bamboo
- That allows creating curved surfaces
- Stable upon creating structures by iteration



Fig.52: Skeletal representation of hemisphere



Fig.53: Building blocks under making



Fig.54: Stages of making the building blocks

Manufacturing

Dendrocalamus giganteus variety of bamboo was the raw material.

- Cut cross sectional at one inch thickness to create building block body
- Cut into pieces measuring 3 inch in curvature
- Drilled holes at opposing faces , diagonally apart
- Processed long thin cylindrical rods from the core of bamboo which are exposed to fire to remove bamboo strands
- Used the rods as integrated connecting member along with the body – fixing them in the drilled holes with one cm protruding outwards [Fig 54]

Challenges faced

- Fixing the rods at correct offset from block body
- Making sure that the drill holes don't overlap each other
- Preventing breakage of bamboo along its length – hence size limited to 3 inch
- Deciding on joining between blocks – how? in what pattern
- Identifying principles/concepts that could be taught via the toy



Conclusion

After spending a month at Uravu, we bid farewell to Uravu and Wayanad. It was a month in which we learned a lot and were successful in getting our hands accustomed to working with bamboo. The insights we had about the challenges related to the functioning of an NGO, hurdles for the craft sector and marketing of handicrafts were new. Facts and ideas learned at IDC helped in identifying the role design had to play within the context at the same time looking out for different realms to explore. We were able to try out different concepts with the available medium and expertise.

The outlook on leading a simple life gets even simpler than one expects and it is clearly visible in the lives of the village members. Interactions with other interns and overseas students were also fruitful in gaining new perspectives. The visit to different units associated with Uravu helped us interact with a larger crowd.

Apart from the NGO, the district of Wayanad was an escape into the lap of Mother Nature. Mind was rejuvenated and fresh after spending quality time at a place that sets you free.

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