

INNOVATIONS AT THE BASE OF THE PYRAMID  
A PROJECT LOCATED IN AMAZON // BRAZIL

PEDAL POWERED  
CASSAVA PEELING  
MACHINE



LUND UNIVERSITY // SWEDEN  
AN NI LE // 2012



AMAZON FLOODPLAIN - VÁRZEA





# LUNDS UNIVERSITET

Lunds Tekniska Högskola

Degree Project for Master of Fine Arts in Design

Main Field of Study Industrial Design

Lund University / School of Industrial Design.

Examiner: Charlotte Sjödel - Assistant Professor

Supervisor: Olof Kolte - Lecturer, Designer

Supporter: Andreas Larsson - Associate Professor

Contributer: Per Liljeqvist - Lecturer, Designer

2012

ISRN: LUT- DVIDE/ EX- - 12/50183- SE

**INNOVATIONS AT THE BASE OF THE PYRAMID**  
**A PROJECT LOCATED IN AMAZON // BRAZIL**

**PEDAL POWERED  
CASSAVA PEELING  
MACHINE**

# ACKNOWLEDGEMENTS

First of all, I would like to thank my Examiner, Charlotte Sjödel, for her critical and invaluable advice to this project.

I would like to thank my Supervisor, Olof Kolte, for his guidance and his great patience, encouragement and advice throughout this project and the entire length of this Master Programme.

I would like to express my great appreciation to the Innovation Engineering Group, Department of Design Sciences, Lund University for giving this unique opportunity to work on such meaningful topic. Especially Professor Andreas Larsson, for his outstanding support, no matter situation, he has always gone the extra mile to help me. His insightful knowledge and his generous spending on the time and finance have given me unlimited conditions to fulfill this Projects.

I also would like to thank Researcher Santosh Jagtap for introducing me to this project.

Thank you for the cooperation from Blekinge University, especially Professor Cesar Levy Franca for his useful advice and great help as a focal contact to prepare the fieldtrip to Manaus.

I also would like to express my deep gratitude to all Professors in UFAM, especially Professor Henrique Periera for all of his gentle support and caring for the Project and for me as visitor in Manaus. I want to give my special thanks to all friends in UFAM for helping me and for putting a lot of personal time and commitments to my project and wellness in Manaus, especially Gisele Cortez for her great contribution and kindness.

I would like to send my warmest thanks to people in the village

Nossa Senhoras das Gracas for all of their kindness and for giving me one of the most beautiful experience in my life.

My thank must also goes to Per Liljeqvist, who, in spite of having practically no spare time, still managed to help and advise me on the project and introduce me to the Osborn International.

My grateful thanks are also extended to all members in IKDC who have contributed, supported and helped me throughout this project and my entire study in Lund. A huge thank to the experts of IKDC Workshop: Jan-Åke Larsson, Göran Larsson, Sergej Rumjantsev, Claes Dorthé and David Eriksson.

I would like to acknowledge the support of OSBORN INTERNATIONAL as a brush supplier to this machine, especially Carl Jansson for his professional and effective work.

Thank you Johanna Bengtsson for being my partner during the research phase especially the fieldtrip and the testing trip to Amazon Region. Thank you for sharing with me this wonderful experience.

Last but not least, I would like to give my special thanks to my families, my brother Nhat for his wise advice and language assistance, and my husband Vu for all of his patience and unobtrusive supports as always!

Thank you so much!

Tack så mycket!

Muito Obrigada!

# TABLE OF CONTENTS

ACKNOWLEDGEMENT	6
TIMELINE	10
INTRODUCTION	12
ABSTRACT	18
TARGET GROUP	20
<b>CHAPTER I</b>	<b>22</b>
DESIGN FOR THE BOP	
THE BASE OF THE PYRAMID – BOP	24
THE FORTUNE AT THE BOP	30
THE BOP STRATEGY	32
BOP INNOVATION	34
DESIGN FOR BOP	36
INSPIRATION	42
BRAZIL // KEY FACTS AND FIGURES	46
AMAZON REGION	50
WOMEN OF THE RURAL	52
RURAL OF THE AMAZON	54
DESIGN THINKING	56
RESEARCH METHOD	60
BRAINSTORMING	66
INITIAL BRIEF	68
PREPARING FOR THE FIELDTRIP	70
NETWORKING	72
<b>CHAPTER II</b>	<b>74</b>
THE FIELDTRIP TO AMAZON RAINFOREST	
MANAUS	76
THE RAINFOREST	80
RIO NEGRO - RIO SOLIMÕES	82
AREA IN FOCUSED – VARZEA	88
FIELDWORKS	90
SANTA LUZIA COMMUNITY	92
NOVO AIRÃO	96
NOSSA SENHORA DAS GRACAS	100

FIELDS OF INTEREST	104
JUTE FIBER	106
CASSAVA CROP	112
FARINHA	114
CASSA DE FARINHA	116
FARINHA PRODUCING	118
PEELING CASSAVA	122
SUMMARY & CONCLUSION	124

### **CHAPTER III 126**

#### A PEDAL POWERED CASSAVA PEELING MACHINE

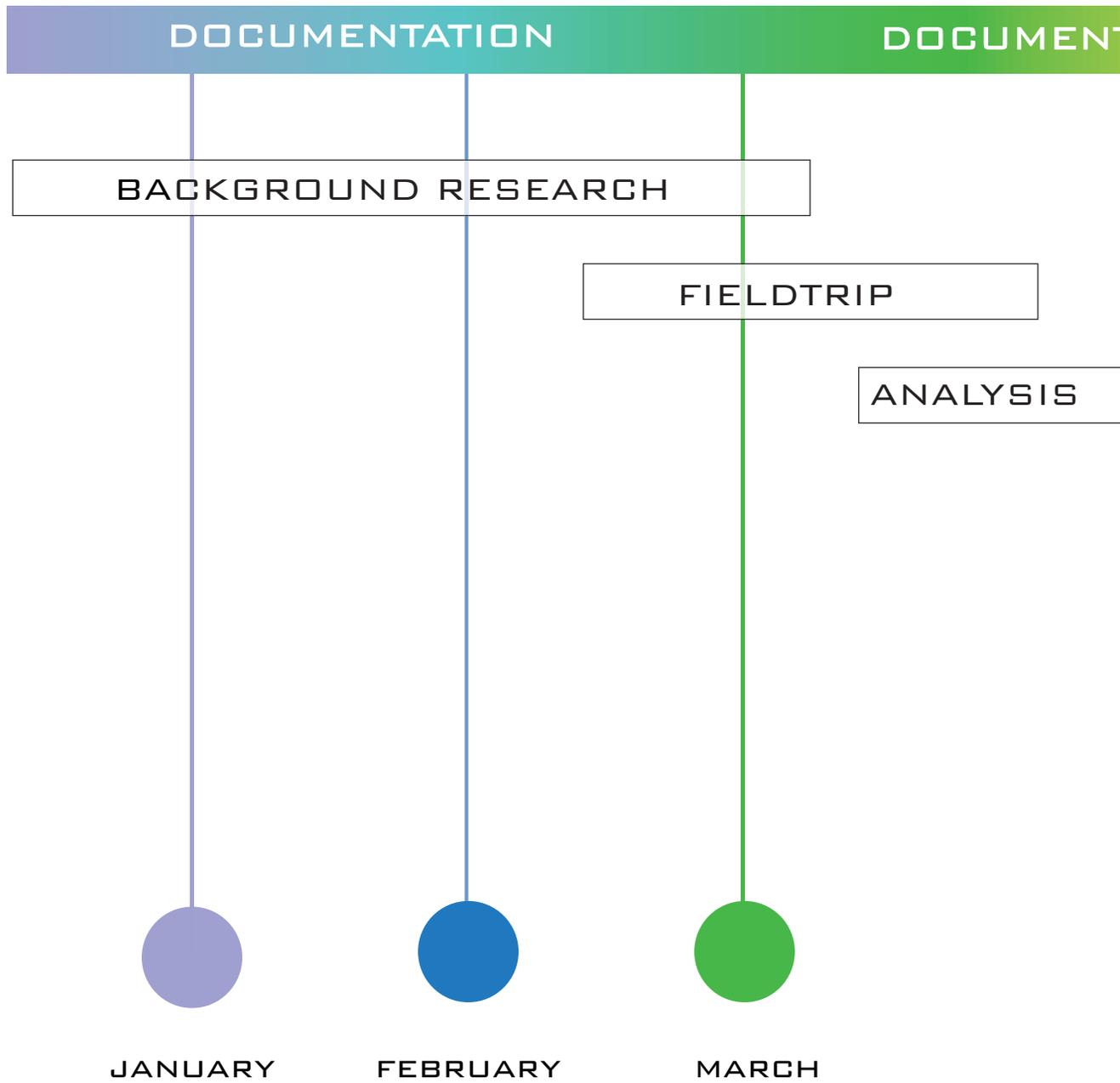
ABRASIVE PEELING TECHNIQUE	128
EXISTED LOW-COST MACHINES	130
EXISTED HIGH-TECH SOLUTIONS	134
BRAINSTORMING	138
BRIEF	140
PEDAL POWER	142
TESTING BRUSHES	144
BRUSH PRODUCING	148
CONCEPT DEVELOPMENT	150
SCALE MOCK-UP	154
PROPORTION DEVELOPMENT	157
3D DEVELOPMENT	158
TECHNICAL CONCERN	160
RESULT	168
USING INSTRUCTION	176
PRODUCING & MAINTAINING	177
PRODUCT MANUAL	178

### **CHAPTER IV 186**

#### DELIVERY

THE TRIP BACK	188
LOCAL METAL FABRICATORS	190
AGROECOLOGY PRODUCT FAIR/MANAUS	192
THE MACHINE HAS ARRIVED	194
DISCUSSION	200
REFERENCES	204

# TIMELINE



PRESENTATION DOCUMENTATION

ANALYSIS

CREATION

REALIZATION

PRESENTATION

DELIVERY



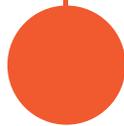
APRIL



MAY

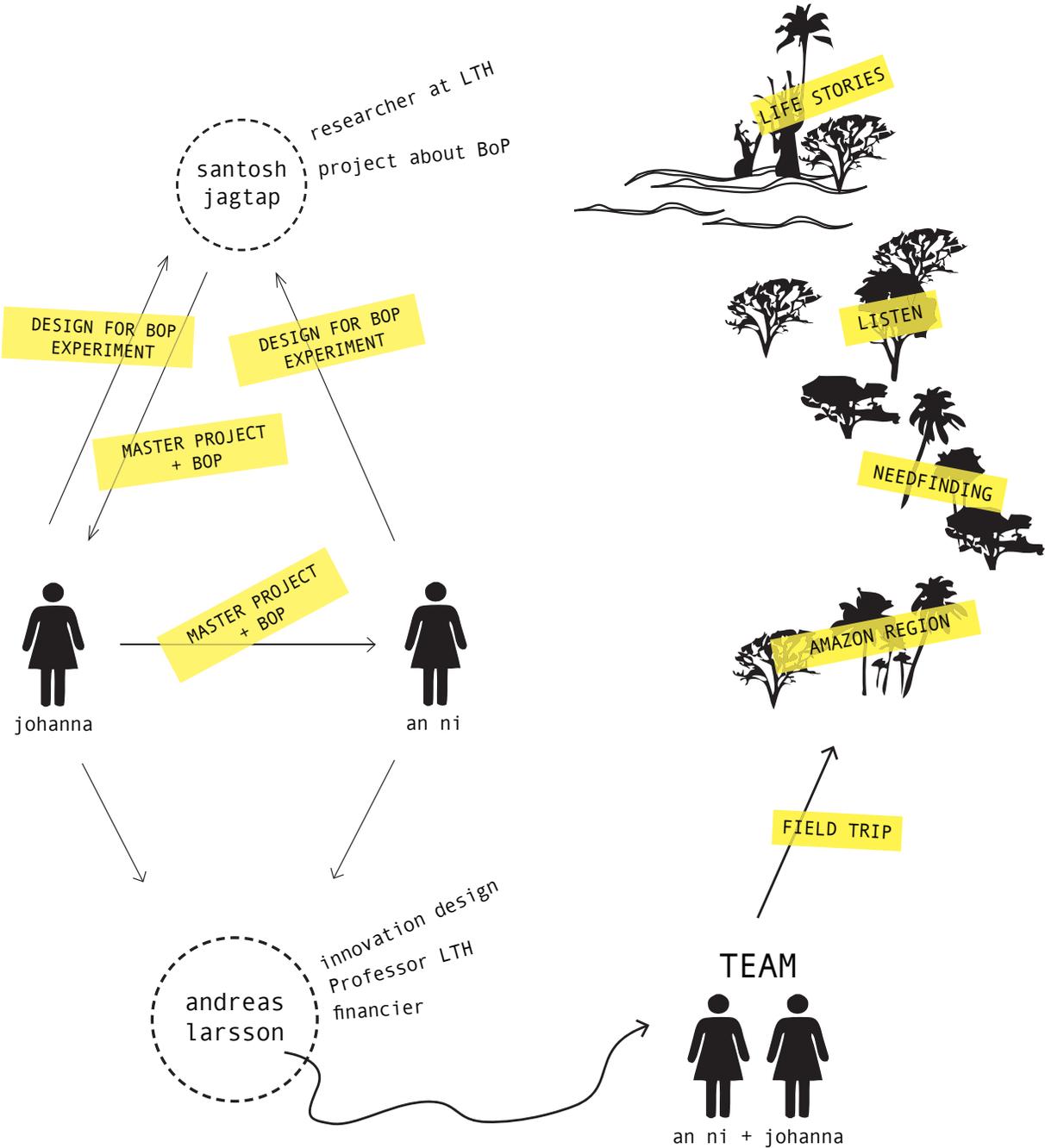


JUNE



JULY

# INTRODUCTION



Choosing a meaningful research topic for the Master's thesis was a challenge for me in the beginning. I am a designer from a "developing country" and I always want to do something that relates to my background. For me the most important criteria to choose a topic, which I am going to spend more than 5 months on, is that I should find it both fascinating and socially significant.

That the reason I felt very fortunate to get a chance to know about the Design Project for the Base of the Pyramid (BoP) from Santosh Jagtap, a post-doc researcher in the Innovation Engineering group of the Department of Design Sciences, Lund University. I was totally convinced and interested in BoP after attending at a presentation of Santosh Jagtap, I then voluntarily participated in his experiment about designing tangible products for developing countries. It was more than exciting when I got information from Johanna Bengtsson, a classmate who also participated in Santosh's Experiment, about the possibilities to connect our Master's Thesis to the BoP's project. *The project refers to the poorest people in the world, the billions of people that are living on less than a few dollars per day, and which are currently underserved by current products and services.* We were then introduced to Dr Andreas Larsson, Associate Professor and Head of Subject of Innovation Engineering, Department of Design Sciences, Lund University, who will play a key role in supervising and supporting the project.

With the purpose to explore the needs of BoP people living in the Amazon region in Brazil, and design and develop

conceptual solution proposals for how new products and/or services could satisfy the identified needs, I would have an opportunity to spend 1 month for the field trip in the heart of the Amazon region in Brazil. I was really aware about the massive workload that I would handle in just about 5 months to complete this project. However, more than ever, I really wanted to take the challenge and test myself by approaching another country across the Atlantic Ocean with a culture, language and environment that was completely new to me.

In addition, bringing with me practical experiences and special traditional knowledge from a tropical and "developing" country, I believe I can contribute to the Project. Moreover by participating in this BoP project, which refers to the poorest people in the world, I hope I can gain many valuable knowledge and experiences that definitely useful and applicable for my future career.

That was the reason, together with Johanna Bengtsson, we formed a team for the research phase that we spent one month for the field trip in the Amazon Rainforest. Where we LISTENED to LIFE STORIES. Even later on, we had different fields of interest and decided to develop into two different projects, we shared the same target of people in the riverine Amazon, and most importantly, we shared the same spirit and passion in designing for people in the BoP markets and Amazon Region particularly.







**LUNDS TEKNISKA HÖGSKOLA**  
Lunds universitet

Institutionen för Designvetenskaper  
Andreas Larsson

### **Opportunity for Master's Thesis/Degree Project**

#### *Project domain*

The Innovation Engineering group at the Department of Design Sciences would like to offer Master's Thesis/Degree projects in the area "Innovations at the Base of the Pyramid" (BoP). The BoP refers to the poorest people in the world, the billions of people that are living on less than a few dollars per day, and which are currently underserved by current products and services.

#### *Purpose*

The students will explore the needs of people living in the Amazon region in Brazil, and design and develop conceptual solution proposals for how new products and/or services could satisfy the identified needs.

The projects will be performed in collaboration with Blekinge Institute of Technology in Sweden (BTH) and Universidade Federal do Amazonas in Brazil (UFAM). Also, Brazilian non-governmental organizations (NGOs) will be involved.

#### *Needfinding*

Students will have an opportunity to visit Manaus in the heart of the Amazon region in Brazil (tentatively in March of 2012) to explore the needs of BoP communities' in the region.

#### *Student profile*

The projects are open to students from any department and faculty at Lund University. Students are allowed to decide their particular area of interest (e.g. water and sanitation, agriculture, healthcare, energy, transportation, ICT, education, etc.). We highly welcome cross-disciplinary teams of students. We are initially looking for 2-4 students in total.

#### *Contact*

If interested, please contact one of the following persons:

Andreas Larsson, Associate Professor, Innovation Engineering, Department of Design Sciences, 070-332 18 74, [andreas.larsson@design.lth.se](mailto:andreas.larsson@design.lth.se)

Santosh Jagtap, PostDoc, Innovation Engineering, Department of Design Sciences, 076-628 84 49, [santosh.jagtap@design.lth.se](mailto:santosh.jagtap@design.lth.se)

# ABSTRACT

The Base of the Pyramid (BoP) refers to 4 - 4,5 billion people in the world, who are living on less than a few dollars per day. This majority of the world's population has little resources and is usually considered as a group with no purchasing power and therefore is currently unserved and underserved by current products and services. However, more than any others, the low-income consumers are constantly and eagerly looking for products that can improve their living and working quality at an affordable price. Hence it is important today to re-conceptualize and pay attention to the value-demanding customers at the BoP. This is also considered as mission to offer low-income people pathways to prosperity. By investing in the 4- 5 billion-person market, will engage in ways to do well (make profit) and do good (improve humanity).

This Master's Degree Project is supported by the Innovation Engineering group at the Department of Design Sciences, Lund University, in collaboration with Blekinge Institute of Technology, Sweden and Universidade Federal do Amazonas, Brazil. An one-month fieldtrip has been taken place at the rural communities near Manaus, Amazonas, focused on the target of low-income people living in the Amazon region in order to access closer to the daily life of local and clearly understand the context of the people within.

Cassava is the third most important crop plant after rice and maize in Asia, Africa and South America, and its flour is a primary calorie source in tropical regions around the world. In the Amazon region, Cassava roots are processed into a type of flour called Farinha, which is extremely common and is used as a basic staple food. The product also provides an

important income to huge numbers of households in the rural areas.

Transforming cassava into flour is a long process which takes a couple of days and basically includes six steps: Peeling, Washing, Grinding, Drying, Sifting and Frying. Men usually engage in machine operations for grinding, pressing and sifting, while women and children are usually responsible for any manual operations such as peeling, washing and frying. It has been reported that peeling the roots by hand is a major problem and takes 65% of the total time of the whole process. This hard and tedious job has low productivity and high product losses, and it is very time consuming and requires physical labour in poor working conditions. However, machines for peeling cassava are rare in this region due to the high cost of available machines in the market, the scarcity of electricity, and high cost of gas. How could this be improved?

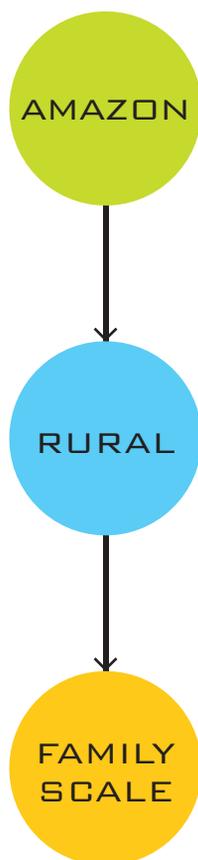
My goal in this project was to design and develop a solution for how a low cost product could satisfy the identified needs, thinking about the importance of rural development and poverty alleviation and how small scale productions can contribute to households and livelihood security.

The result is a cassava peeling machine that improves working conditions, increases the productivity, reduces product losses, reduces time consumption and physical labour. Due to the limit of electricity and high cost of gas, a pedal-powered concept was chosen. The rotating drum efficiently maintains the purpose of rubbing the cassava skin off, using high-tech abrasive rollers with wire brushes.

# TARGET GROUP

Despite being the strongest economy in South America, Brazil is one of the countries most deserving of the name "land of contrasts" with a big gap between City and Rural, Rich and Poor. This project will target in the FAMILY SCALE PRODUCTION IN RURAL AMAZON REGION OF BRAZIL with reasons below:

BoP people living in rural areas generally subsisting in difficult conditions and degrading environments, have limited access to basic infrastructure and technology and experience only partial integration to fully operative markets. As a result, they face limited opportunities to make the most of farm production or other income generating activities.



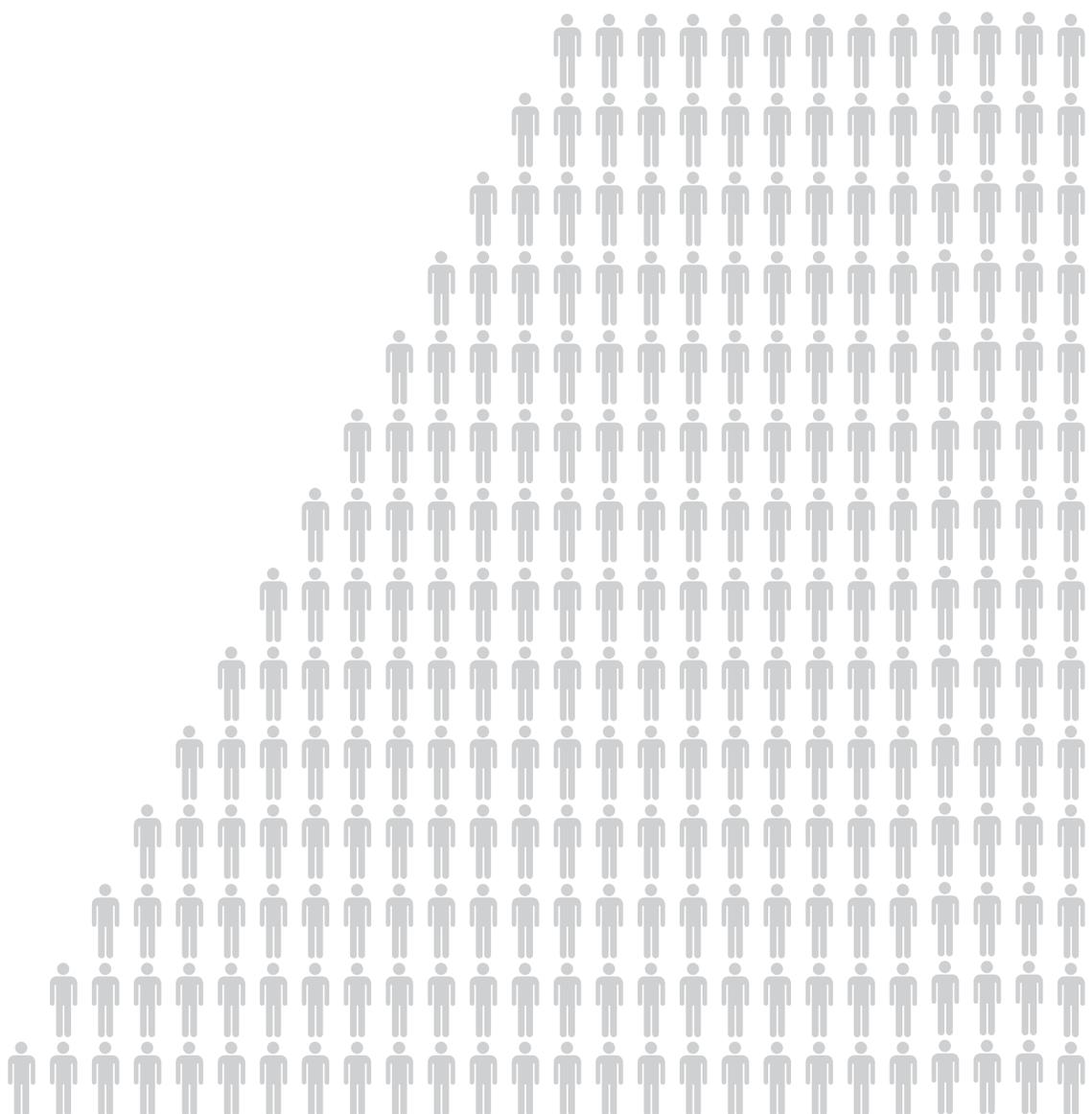
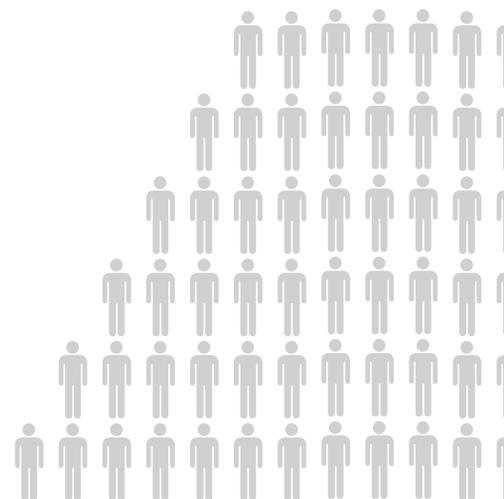
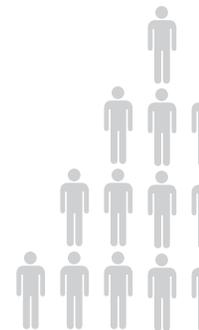
The Amazon region of Brazil: comprises 61 percent of Brazil's land area (5.3 million square kilometres), with a population of 20 million people.

Almost 80% of the rural population lives in conditions of poverty, about 5% of the urban population is classified as extremely poor, compared to an estimated 25% of the rural population.

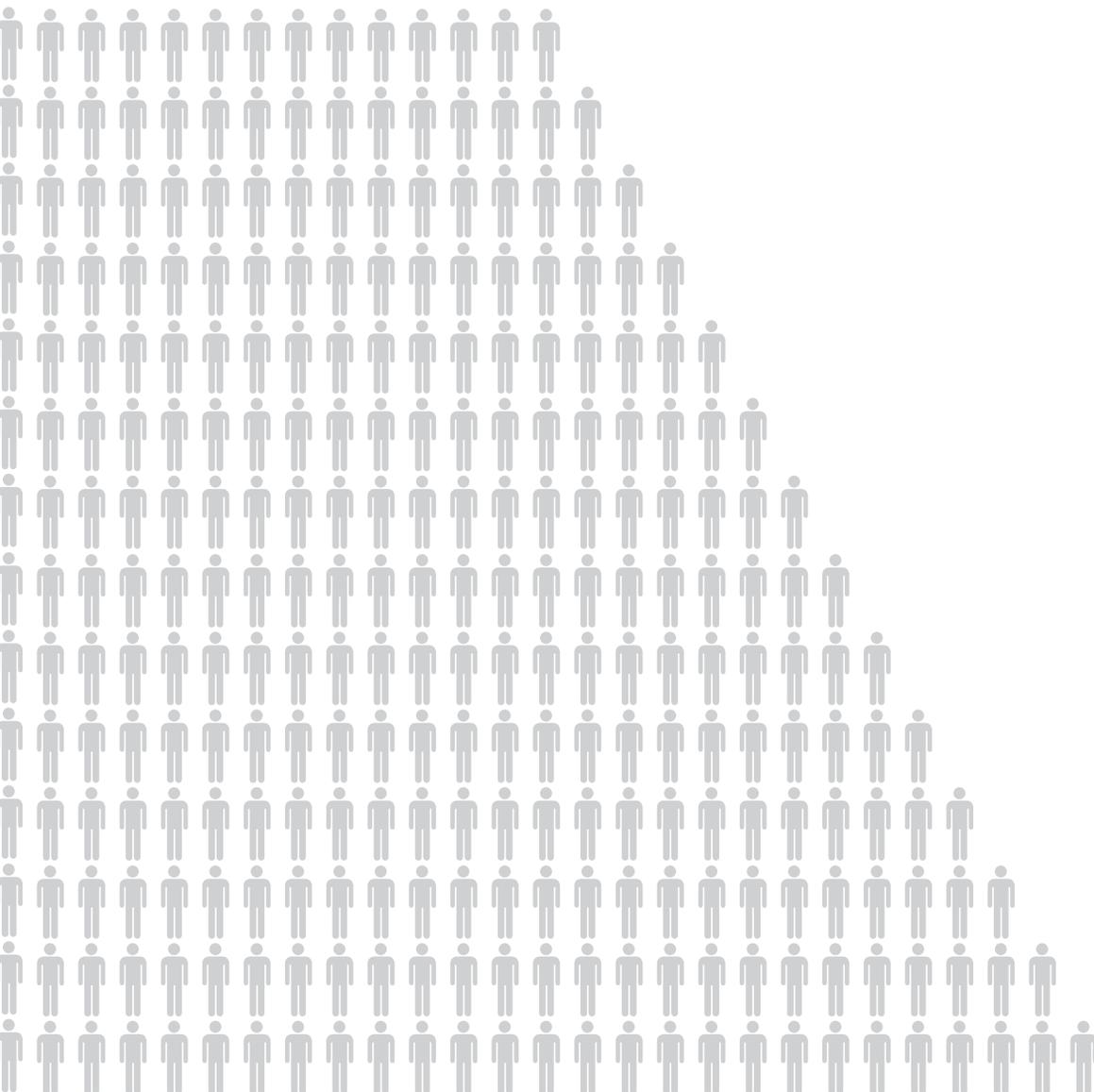
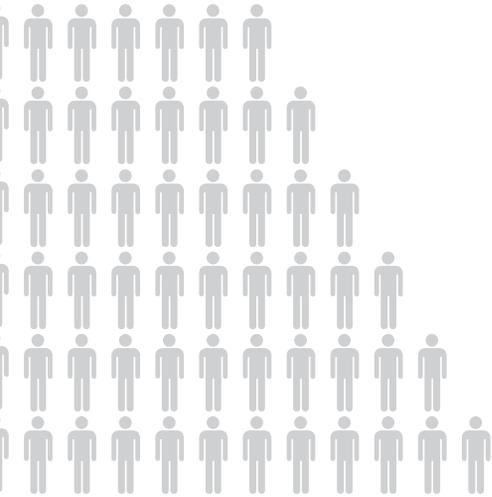
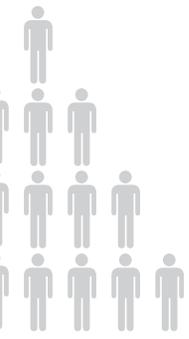
40 per cent of poor rural households are made up of smallholder farmers relying on their produce for their livelihoods. On average, about one quarter of smallholder farmers are poor.



A WOMEN WORKING IN CASA DE FARINHA IN AN AMAZON RIVERINE VILLAGE



# CHAPTER I: DESIGN FOR THE BOP



## THE BASE OF THE PYRAMID - BOP

### WHAT IS THE BOP?

The World Economic Pyramid is divided into three tiers: The Top of the Pyramid (ToP), the Medium of the Pyramid (MoP) and the lowest tier, the Base of the Pyramid or also called Bottom of the Pyramid (BoP). The BoP refers to 4- 5 billion people who have under \$2 for living per day. This majority of the world's population has a little resource and usually considered as a group with no purchasing power and therefore is currently unserved and underserved by current products and services.

The expression "Bottom of the pyramid" was already used in 1932 by Franklin D. Roosevelt, in that period, president of the USA. And later after the appearance of the article "The fortune at the bottom of the pyramid" published by C.K. Prahalad and Stuart L. Hart, the expression became more widely known (Peter Grootveld, 2008)

The term BOP is used to indicate two interrelated issues: an economic situation of 4- 5 billion low- income individuals; and an emerging market with huge potential of serving an underserved customers and improve the living condition.



## LIVING AT THE BOP

The BoP is characterized not only by low income but also by several other shared characteristics:

- Significant unmet basic needs, lack access to water and sanitation services, electricity and basic health care.
- Lack of supported facilities for working, usually work under poor conditions and therefore getting damage to health and reduce productivity.
- Limits in economic opportunities; producers often lack good access to markets to sell their products and have no choice but to sell to traders or to middlemen for low price.
- Impacted by a BOP penalty. For example, poor people usually or perhaps always pay higher prices for basic goods and services than do wealthier consumers, either in cash or in the effort and they often receive lower quality as well. For some services BOP consumers lack access altogether.



## THE RURAL BOP

According to the International Fund for Agricultural Development (IFAD, as cited in Gilvan, Anne, Álvaro, Eduardo, Rodrigo, Igor 2009), 75% of world's poor live in rural areas of developing countries, which comprise approximately 800 million people, and this proportion could remain the same at least until 2040. The alarming poverty level in rural areas of developing countries has been raising concerns about the synergistic interaction between rural poors and their surrounding environment (Wunder, as cited in Gilvan et al. 2009). As rural poors rely mainly on agriculture and related activities for their livelihood (Sherbinin; Netting, as cited in Gilvan et al. 2009) and as contemporary processes such as climate change, rising energy and food prices, agro-fuel production and increasing migration and urbanization are reshaping the face of poverty in rural societies, IFAD (2007, as cited in Gilvan et al. 2009) suggests that domestic investments and external assistance should focus on rural areas and particularly on small-scale agriculturalists. Some authors argue that the promotion of sustainable economic development in rural settings could increase employment opportunities, reduce regional income inequalities, prevent rural-urban migration, and ultimately reduce poverty (Anriquez & Stamoulis; Perz; Grossman, as cited in Gilvan et al. 2009).

## SMALL SCALE PRODUCTION

In the BoP, small scale producers usually share the same problems. They do not have access to up to-date information in order to respond to market demand. They often face extreme economic, social and physical disadvantages. Further, because they lack access to technical advances that would allow them to scale their businesses, their products have high production costs, which in turns prohibits most rural farmers from competing with the larger companies.

Supporting small scale productions means offering large numbers of people in the rural livelihood security - that is food security and cash income. If small scale productions have higher productivity, more jobs will be created for greater human labour input.

## THE FORTUNE AT THE BOP

C.K.Prahalad and Stuart L.Hart who called attention to the "The Fortune at the Bottom of the Pyramid" proposes that business, governments, and donor agencies stop thinking of the poor as victims and instead start seeing them as resilient and creative entrepreneurs as well as value-demanding consumers. The theory is that the world's largest, most exciting, and fastest-blooming new market is at the Base of the economic Pyramid which constituted by the 4- 5 billion of poorest people.

Although the general assumption is that the poor have no purchasing power and therefore do not represent a viable market, Prahalad successfully proved that the BoP can be good customers and has enormous opportunities for multinational companies to serve them profitably. By virtue of their number, the poor represent a significant latent purchasing power that must be tapped. For example, if we take nine countries: China, India, Brazil, Mexico, Russia, Indonesia, Turkey, South Africa, and Thailand, collectively they are home to about 3 billion people, representing 70 percent of the developing world population. In Power Purchasing Parity terms, this group's Gross Domestic Product is \$12.5 trillion, which represents 90 percent of the developing world. It is larger than the GDP of Japan, Germany, France, the United Kingdom, and Italy combined. This is not a market to be ignored (C.K.Prahalad, 2005). The profit problems can easily be cured if the companies provide affordable products and services that meet the needs of dollars-a-day customers.

Moreover, this is also considered as a mission to bring prosperity to the world's poor. By serving the BoP's market, can help billions of the world's poorest people eliminate poverty and improve living conditions. The logic of the concept is that by investing in the 4- 5 billion person market, the private sector firms will engage in ways to contribute to human development. Helping the world's poor alleviate themselves above this desperation line is a business opportunity to do well (profit) and do good (improve humanity) (C.K Prahalad & Allen Hammond, 2002).

And finally, Prahalad find that BoP markets can be an extraordinary source of innovation (C.K Prahalad, 2009).

“ POOR DO PAY FOR THE SERVICES RENDERED TO THEM AND THEY OUGHT TO BE VIEWED AS CONSUMERS RATHER THAN PASSIVE BENEFICIARIES ”

— C.K. PRAHALAD & STUART L.HART

“ I THINK WE HAVE TO RECOGNIZE THAT A WHOLE LOT OF POTENTIAL IS GOING TO COME OUT OF THE BOTTOM OF THE PYRAMID ”

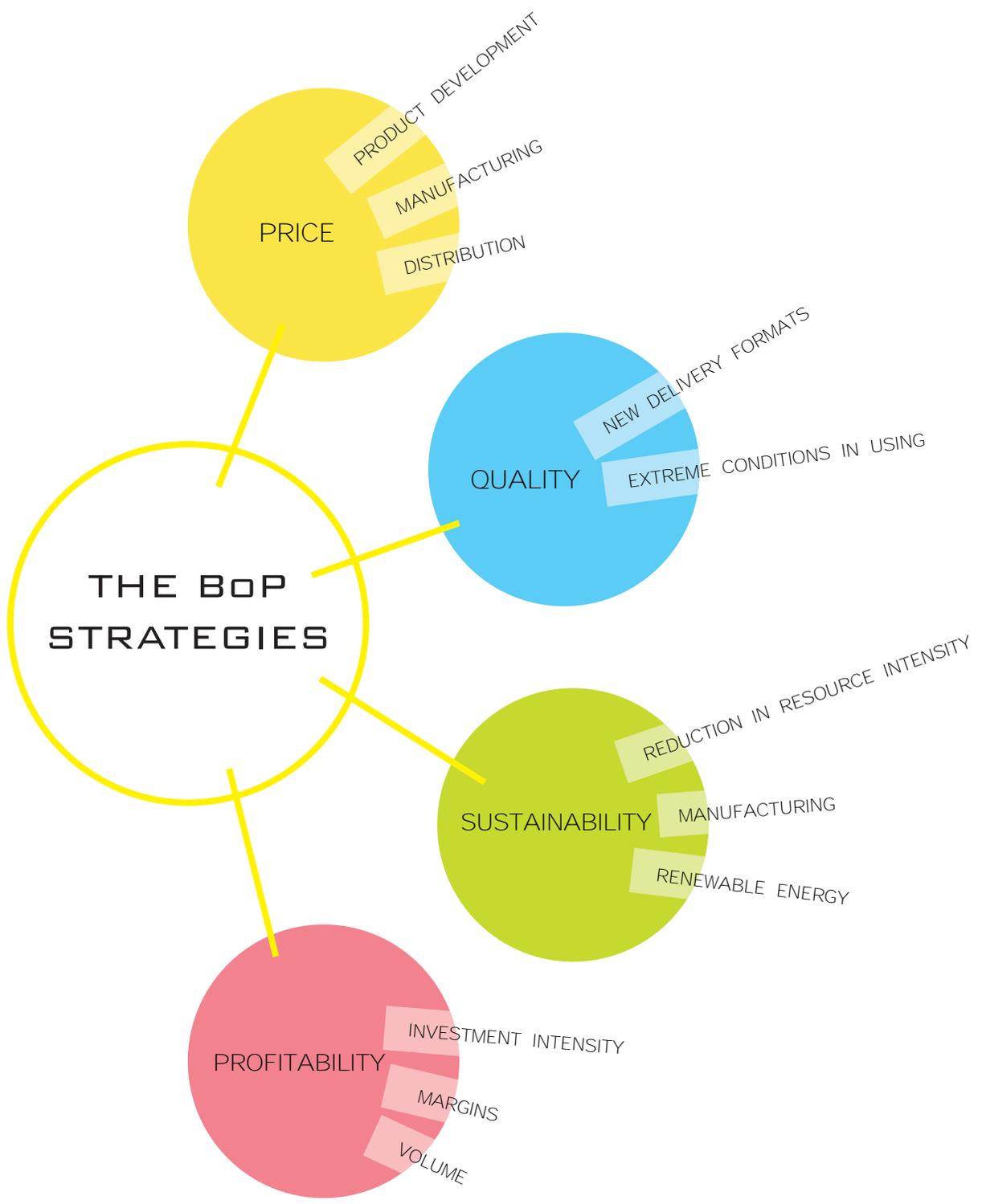
—GHANDA KOCHHAR, EXECUTIVE DIRECTOR RETAIL BANKING, ICICI BANK

## THE BOP STRATEGY

The BOP strategy to serve the underserved more and more has attracted the attention of scientists, entrepreneurs and designers worldwide. The foundation for the BOP strategy was laid by Prahalad & Hart in their book "The Fortune at the Bottom of the Pyramid" promising fortune for economics and at the same time offering perspectives for the poor to escape from the poverty and improve their living and working standard.

Doing business at the Base of the Pyramid means doing business with 4- 5 billion people who have less than \$2 per day to live on. Together they represent a multi- billion dollar market opportunity. Virtually all emerging markets such as Brazil, China, India host vast low- income segments which are widely untapped and provide fundamentally new source of growth and innovation.

(Source: <http://www.bop-research.org>)



## BOP INNOVATION

Designing products and services to meet the needs of the BOP and then efficiently manufacturing and distributing by the capabilities of the modern corporation, Prahalad contends, needs innovations (Prabhu Kandachar et. Delft University of Technology 2009).

Exploring these markets requires simple, low-price, and robust solutions while fitting the local economic and socio-cultural, makes the BoP a very attractive, challenge early market that can be an extraordinary source of innovation. In other words, the BoP needs new solution, sustainable innovation, not just compliance.

By beginning the Innovation Process, there are some points that need to bear in mind:

- Rethink technology platforms and their supporting business models. This might include radical innovations or a mix of high-tech and low-tech solutions. By doing that, the end result must be: simpler, better, more accessible, cheaper and greener technologies.
- Focus on meeting functional needs and services, not just producing more products. This will require identifying new sources of value through a demand-side lens.



## PRAHALAD OUTLINED 12 PRINCIPLES OF INNOVATION FOR BOP MARKETS

Focus on **PRICE PERFORMANCE**

**HYBRID SOLUTIONS** blending old and new technology

**SCALE OF OPERATIONS** across countries, cultures, languages

Reduce resource intensity **ECO- FRIENDLY**

Radical product **REDESIGN FROM THE BEGINNING**

Build logistical and manufacturing **INFRASTRUCTURE**

**DESKILL** services work

**EDUCATE** customers in product useage

Design to suite **HOSTILE ENVIRONMENT**

Adaptable user **INTERFACE**

**DISTRIBUTION METHODS** able to reach the customer

Focus on **BROAD ARCHITECTURE**



## DESIGN FOR BOP

Most companies, designers used to (or still) target in 10% of wealthy customers in the ToP and 20% of MoP, it is important for the business world today re- conceptualize and pay interested in the largest unserved and underserved markets at the Base of the Pyramid. Exploring these markets to alleviate poverty and other sustainabilities problems at the same time exploiting new consumer markets, has posed a tough challenge for the design world. To succeed in the BoP markets, companies or designers will need reconfigure their business and products innovation models. The challenge is to create accessible and affordable products and services solutions while fitting the local economic and socio- cultural preferences without expanding current environmental resource (J.C Diehl and H.H.C.M Christiaans, 2007).

### HOW CAN DESIGNERS GAIN INSIGHT INTO THE BOP CUSTOMER?

Creating products for the BoP markets require a clear understanding of the needs and the context of the people within, designer should engage with the local culture directly in order to understand the local better (J.C Diehl et. al., 2007). The most important factor is the willingness to listen carefully to the local people and understand what they need, not what product innovators think they need. In addition to sustainability benefits such as improvement to health and environment, there must be added value created in the products from which the benefits can be recognized by consumers at the BoP (Chang 2006)

” Like consumers everywhere, the poor are constantly looking for products and services that improve their quality of life at an affordable price. The poor are also vital producers and distributors of an immense range of goods. Companies that are smart enough to tailor their offerings to the needs of low-income consumers and entrepreneurs will thrive in the 21st century. As illustrated in this important volume, the next 4 billion, companies that provide affordable solutions in areas such as housing, sanitation, public transport, and connectivity will also make a vital contribution to human development. ”

LUIS ALBERTO MORENO

President, Inter-american Development Bank



## THE CHALLENGE

THE BOTTOM OF THE PYRAMID POSES A FUNDAMENTALLY QUESTION: HOW DO WE MARRY LOW COST, GOOD QUALITY, SUSTAINABILITY, AND PROFITABILITY AT THE SAME TIME?

C.K. Prahalad/ Stuart Hart



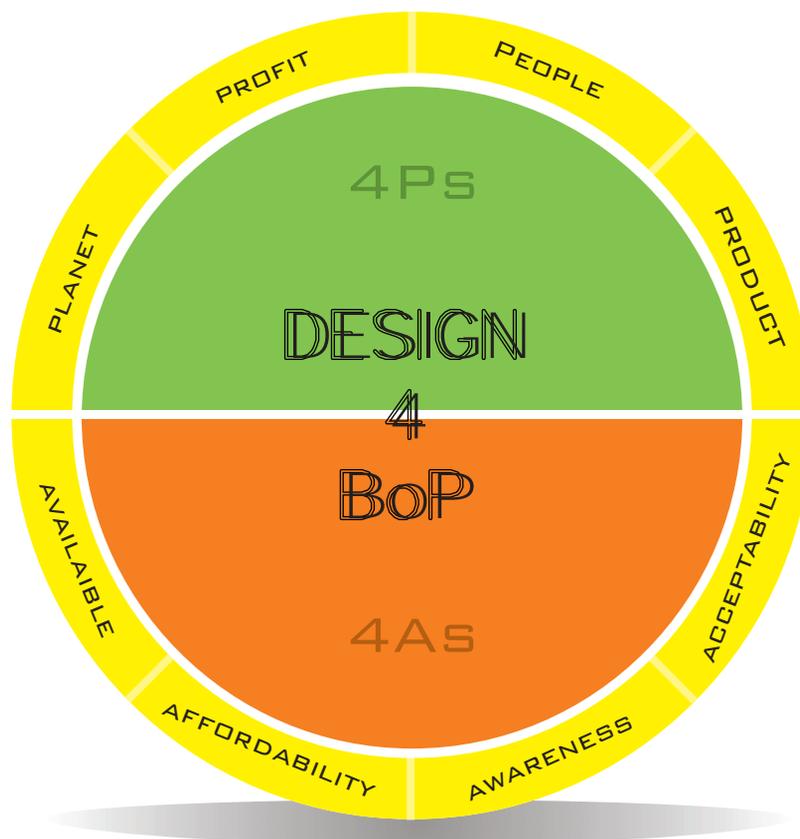


“ I KEEP ASKING WHY 90% OF THE  
WORLD’S DESIGNERS WORK EXCLUSIVELY  
ON PRODUCTS FOR THE RICHEST 10% OF  
THE WORLD CUSTOMERS”

- DR PAUL POLAK // INTERNATIONAL DEVELOP-  
MENT ENTERPRISERS, “OUT OF POVERTY”

## FRAMEWORK FOR DESIGNING FOR THE BOP

How can new business opportunities and product innovation in the BoP be combined with a long-term. Currently, Diehl and Christiaans propose a new framework for "Designing for the BoP. This framework is a merge of the '4Ps' of Design for Sustainability (Crul and Diehl 2006) and the '4As' of Developing successful products and services for the BoP (Anderson 2006; Prahalad 2006)



# DESIGN FOR THE OTHER 90%

"The majority of the world's designers focus all their efforts on developing products and services exclusively for the richest 10% of the world's customers. Nothing less than a revolution in design is needed to reach the other 90% - Paul Polak" In spring 2007, the Smithsonian's Cooper-Hewitt, National Design Museum in New York showcased Design for the Other 90% - an exhibition inspired by Paul Polak - that features affordable and socially responsible objects, including several IDE water irrigation and storage tools. Paul poses the same challenge in Out of Poverty that the exhibition addresses: 90 percent of the world's designers focus on solutions for the richest 10 percent of the world's customers rather than the other 90 percent who need it most. (<http://www.paulpolak.com/html/design.html>)





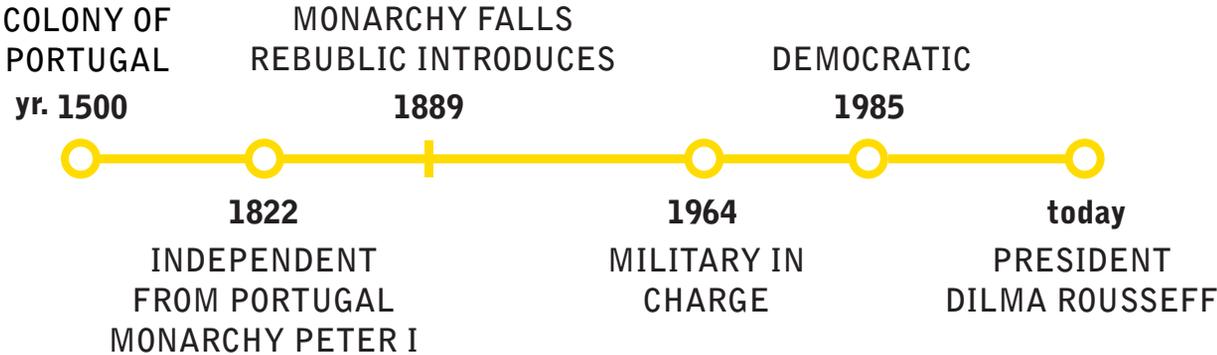


THE BOP PROJECT FOR  
AMAZON RAINFOREST // BRAZIL

# BRAZIL // KEY FACTS AND FIGURES



## TIMELINE



Full name: Federative Republic of Brazil

Population: 196.6 million (UN, 2011) - 5 largest in the world

Capital: Brasilia

Largest city: Sao Paulo

Area: 8.55 million sq km - 5 largest in the world

Forest cover: 56% = 4,776,980 sq km

Contains 65% of the Amazon

Climate Mostly tropical, but temperate in south

Major language: Portuguese

Major religion: Christianity

Current President: Dilma Rousseff

Life expectancy: 71 years (men), 77 years (women) (UN)

Monetary unit: 1 real = 100 centavos

Exchange rate: 1Real = 0.5USD/0.4EURO/3.6 SWE KRONA approx.

GNI per capita: US \$9,390 (World Bank, 2010)

GDP per capita: \$11,845 (2011)

GDP growth: 2.7% (2011)

Economy: Largest in Latin America - 8th largest in the world

Economy grow: 6.5% (World Bank, 2011)

Human Development Index: 0.718 - 84th out of 182 countries

Main exports: Manufactured goods, iron ore, coffee, oranges,  
other agricultural produce

Largest exporter: Soybeans & Beef

Major Sport: Soccer, won FIFA World Cup 5 times

## BRAZIL

Brazil is a South America's most influential country, with an economic giant, its politicians and business leaders are confident that it is on course to become the world's fifth largest economy by 2012. Brazil is often bracketed with India, China and Russia as a grouping of countries developing rapidly and with similar economic potential.

However because of its size and diversity, Brazil is a land of paradox - home to extreme contrasts of wealth and poverty. The richest 10% consume 46.9% of the income, while the poorest 10% get by on 0.7%, according to UN figures. In 2003, the former President Lula introduced a social welfare scheme that has transformed the lives of millions of poor people, but still millions live in poverty and the gap between rich and poor remains really high. (Source: [www.bbc.co.uk](http://www.bbc.co.uk) 2010). This distinction is sometimes referred to as the 'two Brazil's'.

Lifestyles in Brazil's urban areas differ greatly from those in its rural areas. In the large cities, life moves at a fast pace, and a variety of modern conveniences and government services are available. Although many Brazilian city dwellers live in miserable poverty, there are a growing number of skilled, educated Brazilians who have good jobs and enjoy a decent standard of living in the cities. In the rural areas, the slow pace of life has changed little through the years. Large numbers of unskilled laborers continue to work long hours for low wages, and life remains hard.

## BOP in BRAZIL

The North and North-east, has one third of Brazil's population and is also the poorest region. The wealth is based in the south and south-east - the cities of Rio de Janeiro and Sao Paulo and the southern areas heavily settled by European immigrants. The BoP in Brazil constitutes 65% of its population and represents approximately 110 million people, making it a big market that be able to materialize investments and from that if it is to catalyze change the lives of local communities as well as the whole Latin America. The BoP's incomes in current U.S. dollars are less than \$3 a day in Brazil, that value is exchanged in local currency 5.70 Reais, that makes around 171 Reais per month.

Also the facilitated access to consumer credits had positive impact on poverty reduction. Nevertheless poverty remains a rural and urban reality in Brazil, though with very different characteristics. There is a distinction in poverty levels between the countries developed south/east and the north and northeastern parts of it, as it is between megalopolis like Rio de Janeiro or São Paulo and rural regions, for example due to access to basic private and public services. Even if the individual purchase power at the BoP is very low, it represents a market with elevated growth potential.

## AMAZON REGION

The Amazon rainforest is the largest in the world, covering approximately seven million square km (40% of south America). About 1/2 of the planet's remaining tropical rainforests are found in the Amazon. The Amazon is a rich store of biodiversity, containing around a quarter of all terrestrial species. The Amazon river is the second longest in the world, and homes for one fifth of all fresh water drained into the world's oceans. The Amazon basin is also home to more than 30 million people of nine nations: Bolivia, Brazil, Colombia, Ecuador, French Guiana, Peru, Suriname and Venezuela.

About 30 million people live in the Amazon, including more than 300 indigenous communities. Life in Amazon region continues to be based heavily on old indigenous traditions, creating very special relationship for people and nature. Many of these populations live along the river where they have good sources of food, means for transportation and fertile floodplain soils for agriculture. According to the



World Wildlife Fund (WWF) 700,000 km<sup>2</sup> of the country have been deforested since 1970. This is an area almost the size of France and Belgium.

Brazil contains 65% of the whole Amazon rainforest and considered as a land of paradox: one of the richest region in terms of natural services it provides and also in resources and at the same time one of the poorest. Hence the major challenges is to identify ways for the poor to fulfil their basic and fundamental needs and while also are engaged on activities that protects the rainforest.

PHOTO (C) CIFOR



## WOMEN OF THE RURAL BOP

Women always play an important role in both family and society, especially in rural communities where the women's involvements are more significantly. Women contribute substantially to agricultural production, produce half of the world's food and in developing countries, between 60%- 80% of food crops. They women work as both subsistence and commercial farmers, growing both food and cash crops. Women face far greater time constraints than men. They may spend less time on farm work but work longer total hours on productive and household work and paid and unpaid work, due to gender-based division of labour in child care and household responsibilities. Women also are more likely than men to spend their income on the well-being of their families, including more nutritious foods, school fees for children and health care. Women take care for children and family but also contribute key role in social development, traditional reserving and environment sustaining.

However, it seems that poverty is more biased towards women. Small-scale women farmers represent the majority of rural poor populations in developing countries. They produce both subsistence food and cash crops, most of them are working hard under very poor conditions. Because they do not have access to the required resources, inputs and technologies, they may not be able to meet standards for working quality such as health, sanitation, environment, and safe.

Generally, less attention has been given to farming tools

and technology that are both appropriate for women and environmentally safe, particularly as many projects tend to increase the quantity and physical demands of women's crop- production activities.

## RURAL OF THE AMAZON

In Brazil, the incidence of rural poverty is particularly high. Almost 80% of the rural population, about 30 million people, lives in conditions of poverty, and in communities subsisting in difficult conditions and degrading environments (IFAD, 2007a). The poorest and most vulnerable groups among rural poor people are women, people, and ethnic minorities such as Afro-descendants. Households headed by women account for 27% of the rural poor. Child labor is still common among poor households, and in some areas, especially the Northeast, the number of children between 10 and 14 years of age who work to supplement family income is still high.

One of the major causes of rural poverty in Brazil Amazon is the severe inequality of land tenure (IFAD, 2007b). Moreover, the lack of access to formal education contributes to its perpetuation over time. Poverty itself, along with imperfect capital markets, may increase the discount rate and reduce the time horizon of rural smallholders, leading them to adopt low- technological agropastoral activities which contribute to decline in soil fertility (Barbier et al., 1997). This two- way relationship between poverty and production decisions in rural areas is an important dimension of poverty perpetuation and increase in income inequality in the country and elsewhere (Diniz, 2008).

According to Diniz and colleagues (2007), poverty in the Legal Brazilian Amazon is higher than the national average, although inequality is lower, which sets the basis for poverty homogeneity: a combination of high level of pov-

erty with low inequality. The authors state that the region has been experiencing a process that reinforces its poverty structure.

Rural poor suffer from social and economic exclusion, limited access to basic services such as health, education, and housing, and poorly organizational development (Hakkert & Martine, 2003). The lack of sustainable development strategies in these areas not only prevents rural poor from having equitable access to political and economic resources but is also accompanied by low levels of income that prevent them to afford basic private goods and services (Grossman, 1981). In addition, rural poverty in the region is often associated with geographical and institutional isolation (Hakkert & Martine, 2003). This setting propitiates the emergence and perpetuation of structural poverty, which generally affects illiterates, persons with limited portfolio of assets and low working skills, and is mostly found among indigenous communities, rural woman and ethnic minorities (IFAD, 2007a).

# DESIGN THINKING

## DESIGN FOR WELLBEING

Well-being is essentially multidimensional and includes the following dimensions:

- material living standards (income, consumption and wealth)
- health, education, personal activities including work, political voice and governance, social connections, environment (present and future conditions)
- personal and economic security.

Well-being, as indicated above, consists of an economic component (such as the satisfaction of basic needs and wants) and a social component (extent of the satisfaction of the quality of life domains above as well as social rights and cohesion).

Since social progress is made up of three key components: economic well-being, social (quality of life) well-being, and sustainability, each of these components needs to be measured separately.

According to Tobias Larsson & Andreas Larsson, the initiators behind the Design for Wellbeing (DfW) initiative, DfW is a multidisciplinary initiative, with participants from mechanical engineering, health science and human work science (Innovations for life: Design for Wellbeing, 2005). With the main objective is to enhance the wellbeing of persons by using their descriptions of needs as a starting point for product development. Design for Wellbeing also redirects the focus of product development from technology-based development, via needs-based development, to participative product development and innovation.

Based on that objectives, the Design for Wellbeing initiative is defined as:

-  Designing innovative products for increased wellbeing
-  Shaping the future of globally distributed collaboration
-  Educating the product designers of tomorrow

Source: <http://www.designforwellbeing.org>

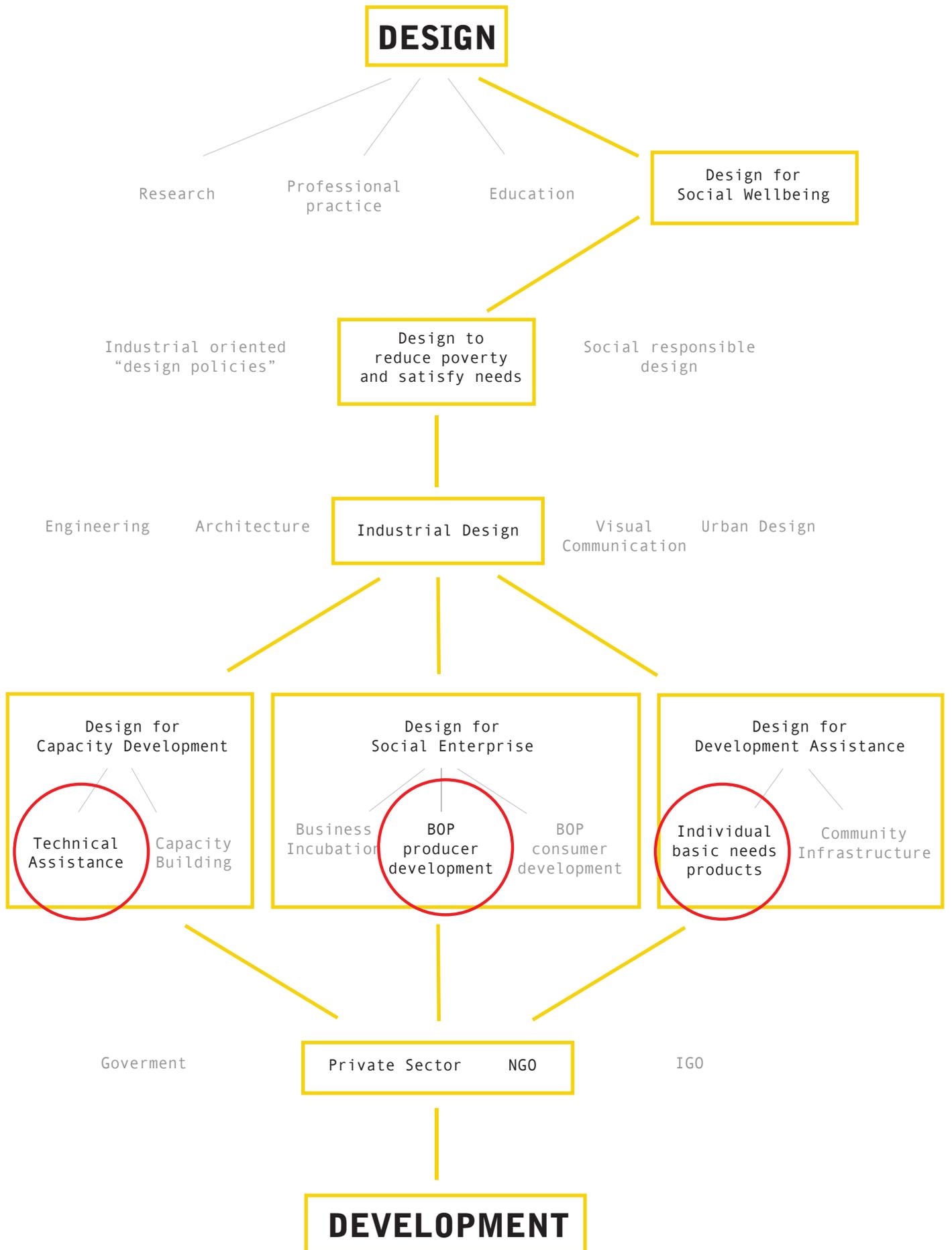
Edan Weis, a researcher in Delft University, The Netherlands, also has introduced a Practice of "Design for social wellbeing", which describes a very broad agenda for positive social change undertaken by various design disciplines including industrial design. Its primary concern is improving human social and economic conditions.

The scope of Design for Social Wellbeing (DSW) includes the provision of basic needs and infrastructure, the promotion of micro- enterprises, the facilitation of humanitarian aid, vocational education and training and the rethinking of design principles in the equivocal terms of sustainable product development and socially responsible design.

DSW is often associated with issues of development, focusing on the lives of people living in poor regions. Much of the practical work of DSW occurs in these countries and is focused on the income- or resource- poor and marginalized social groups.

DSW practice which is concerned in human, economic and community development, has given me a really inspirable foundation to determine my action.

(The practice of "Design for Social Wellbeing"- A case study about Design for Social Wellbeing/BoP Design///Edan Weis)



## RESEARCH METHOD

In addition to the Human Centered Design Toolkit which is really well-known and used widespread as a free innovation guide enhance the lives of people living on less than \$2/day, I were deeply inspired in the Needfinding approaches developed by Robert McKim, the head of Stanford University's product design program. Needfinding gives designers important tools to get closer to the target users then identify needs and develop products for them.

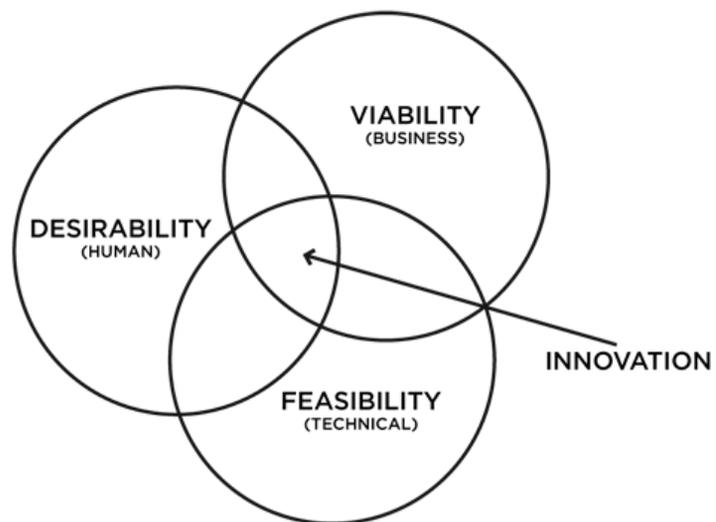
"The most important thing about need finding in design thinking is that we look without presupposing what we are looking for. We trust that our ability to define the problem will emerge during the need finding process."

There are two basic kinds of need finding tools: observations and interviews. Directly observe people's behavior in their own environments to gain a clearer understanding of their situations. Then interview people after the observed activities have been completed to understand the context in which those activities just occurred (Needfinding: The Why and How of Uncovering People's Needs - Dev Patnaik & Robert Becker, 1999)

Source: <http://www.jumpassociates.com/needfinding-the-why-and-how-of-uncovering-people%E2%80%99s-needs.html/3>

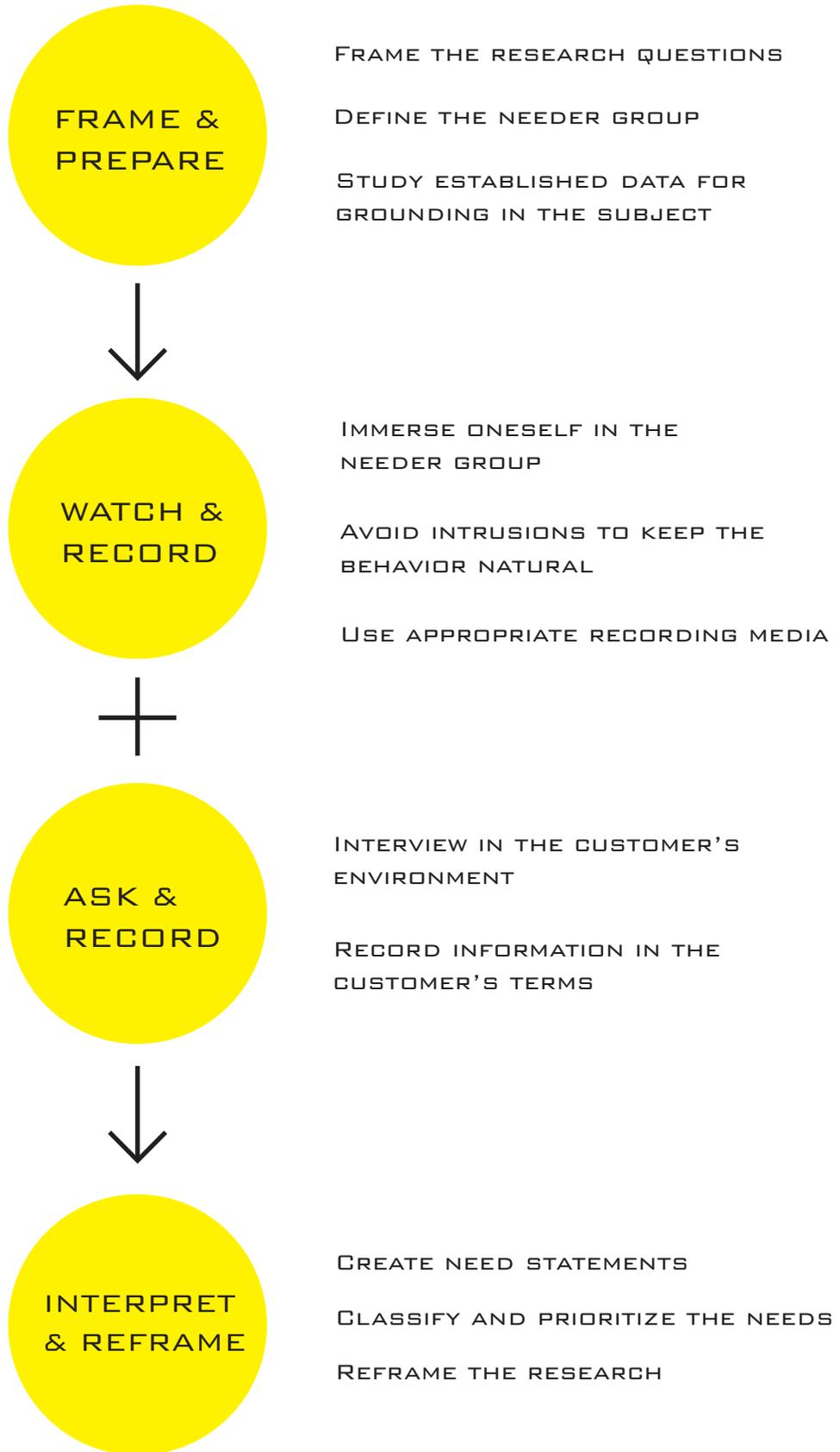
## HUMAN-CENTERED DESIGN

HEAR THE NEEDS OF CONSTITUENTS IN NEW WAYS,  
CREATE INNOVATIVE SOLUTIONS TO MEET THESE  
NEEDS, AND DELIVER SOLUTIONS WITH FINANCIAL  
SUSTAINABILITY IN MIND.

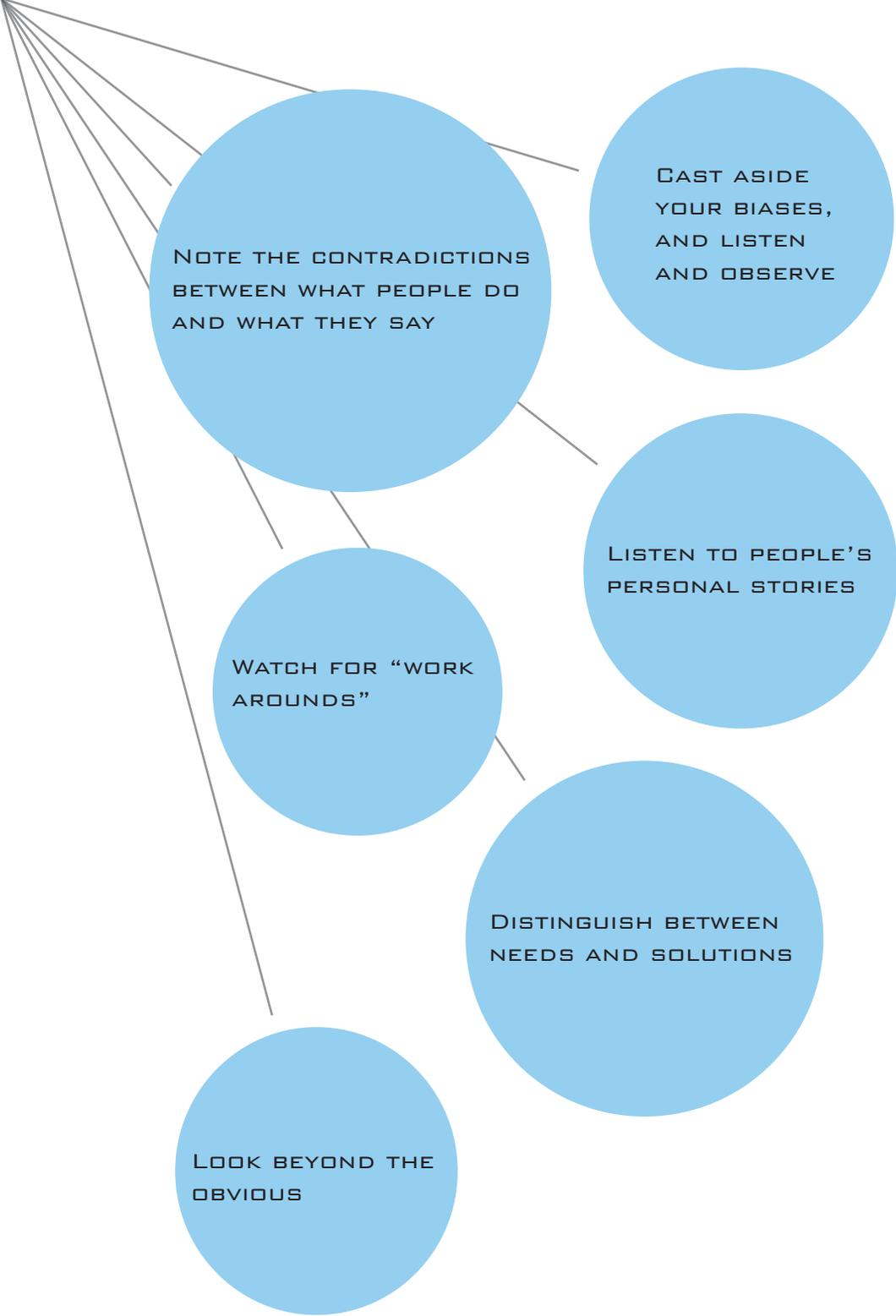


[www.ideo.com/work/human-centered-design-toolkit](http://www.ideo.com/work/human-centered-design-toolkit)

# NEEDFINDING PROCESS



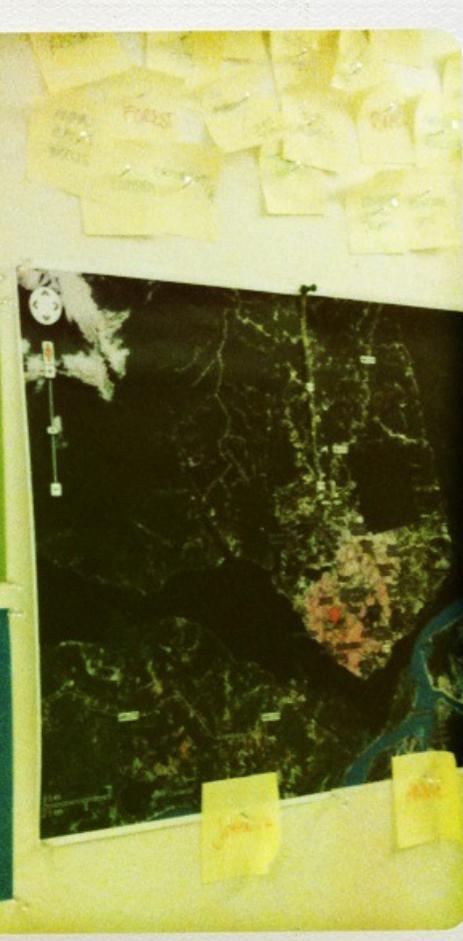
BUT BEAR IN MIND



**BRAZIL**

**amazon**

**MANAUS**



POVERTY IS PROMOUNED DEPRIVATION IN WELL-BEING... INCLUDING LOW INCOMES & THE INABILITY TO ACQUIRE THE BASIC GOODS & SERVICES NECESSARY FOR SURVIVAL WITH DIGNITY -THE WORLD BANK

CONCEPT TEST

TOOLS  
GIVING BIRTH  
KNOWLEDGE  
WOMEN DO EVERYTHING  
Women  
ORGANIZER



They are financially challenged  
Patric

Handwritten notes on a grid background, including a diagram with arrows and text like 'Malva', 'Fiber', 'Story Telling'.

ANDREAS & STUDENTS  
METHODS TO GET CLOSE  
MALVA, JUPE - FIBERS  
BRAZIL MALVA IRANDUSA  
STORY TELLING  
REAL PICTURE LOCAL PEOPLE  
EVERY DAY PEOPLE NOT ECONOMY, NOT CITY

AGRICULTURE ARE A KEY IN THE



QUOTES  
A heart symbol is drawn below the word.



PLAN  
NEED IN POOR COMMUNITY  
SOLD TO THE POOR PEOPLE IN THE COMMUNITY  
DISTRIBUTED IN THE COMMUNITY  
RESPECT MONEY OF THE POOR COMMUNITY  
RISE PRODUCE IN THE COMMUNITY



FINAL PROTOTYPE  
MAY Take part in...  
BOOKLET

to give people the understanding of using their natural resources in a sustainable way  
Annio

CHILDREN  
THE BEST TO SCHOOL  
VIOLENCE



## BRAINSTORMING

I was still searching, reading and trying to absorb as much as information as I can. There were so much inspirations and confusion at the same time, it seemed. In all honesty, it was really hard for me to "pick up a right topic" and go, I was aware that in all probability that things would not go with the way I could imagine. However, I understood that briefing is crucial for a next step as a foundation.

By brainstorming I can be clear about what I want to achieve and that I need to focus for deeper researching in the fields trip. However, I decided to keep the brief not so "tight".

- There are several reasons for me to choose Rural instead of other areas.
- Understanding the important of Small Scale Productions.
- Women usually take main responsibility in households but also work hard in farming or contribute significantly in home business. How are their roles recognized and supported by the community?

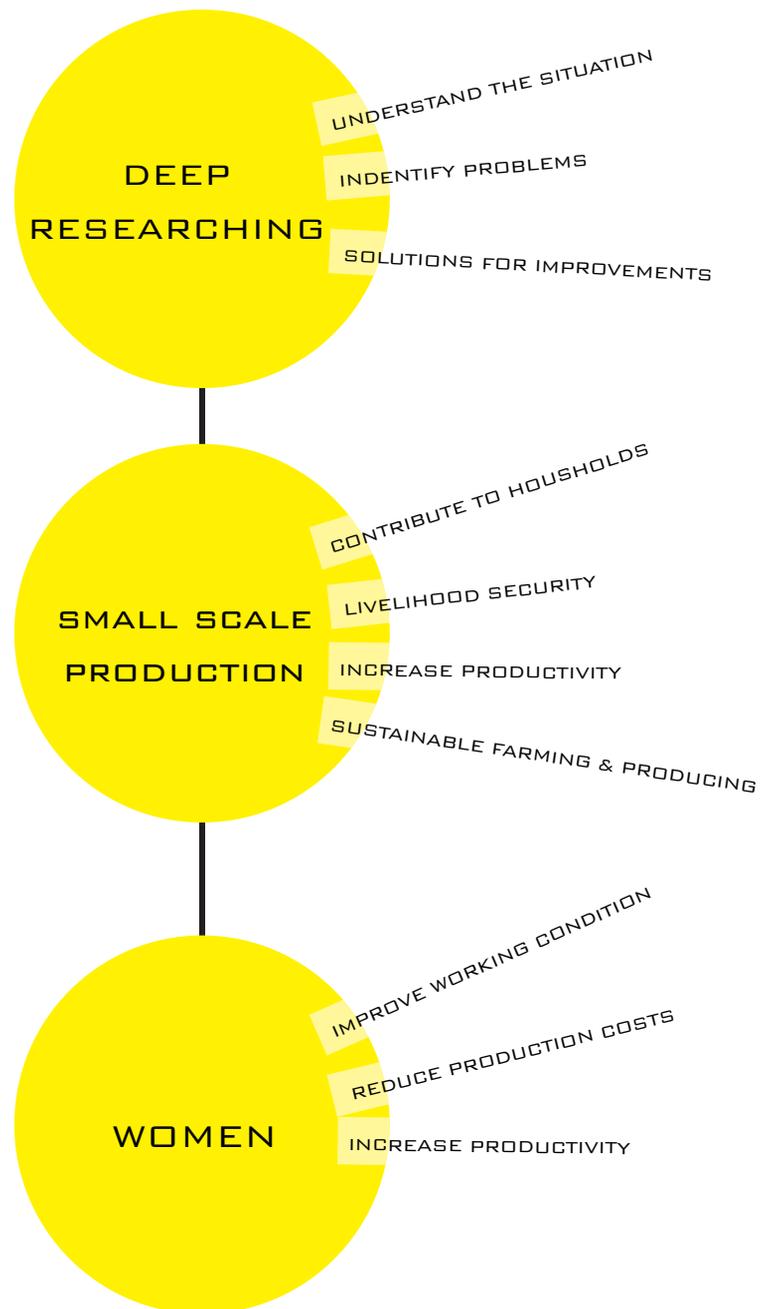
In a gender perspective, how women experience poverty differently compared to men. Seems poverty is more bi-ased towards women, I would like to learn and analyze the constraints and potentials of poor women in Amazon region.

Il  
Il  
A  
th  
se  
W  
tr  
it  
Il  
T  
in  
in  
a  
to  
th  
s  
in  
h  
it  
th  
s  
th  
s  
w  
V  
C  
S  
p  
c  
th  
in  
F  
Il  
th  
m  
o  
ti  
o  
P  
P  
a  
ti  
k  
is  
s  
p  
p

## INITIAL BRIEF

My design goal is to improve the living and working conditions for women and provide opportunities for them to enhance their involvement in activities outside their homes. Also to build up their confidence and enhance their sense of self-realisation.

The challenge is to create accessible and affordable solutions while fitting the local economic without expanding current environment resources (Rocchi 2006). The target is not only to alleviate poverty, but also improve the conditions in which rural women live and work, where traditional utilities such as electricity, water, gas are lacking and communication and transportation structures are poor. Since most BoP communities are ecologically fragile, new products and services will have to be highly eco-efficient.

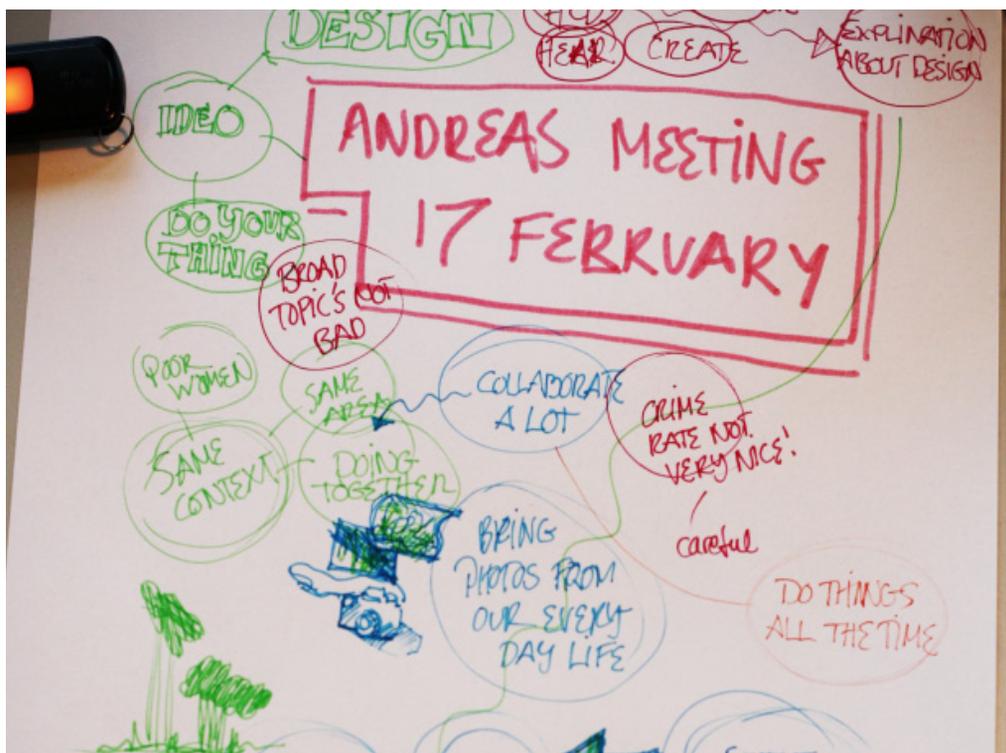
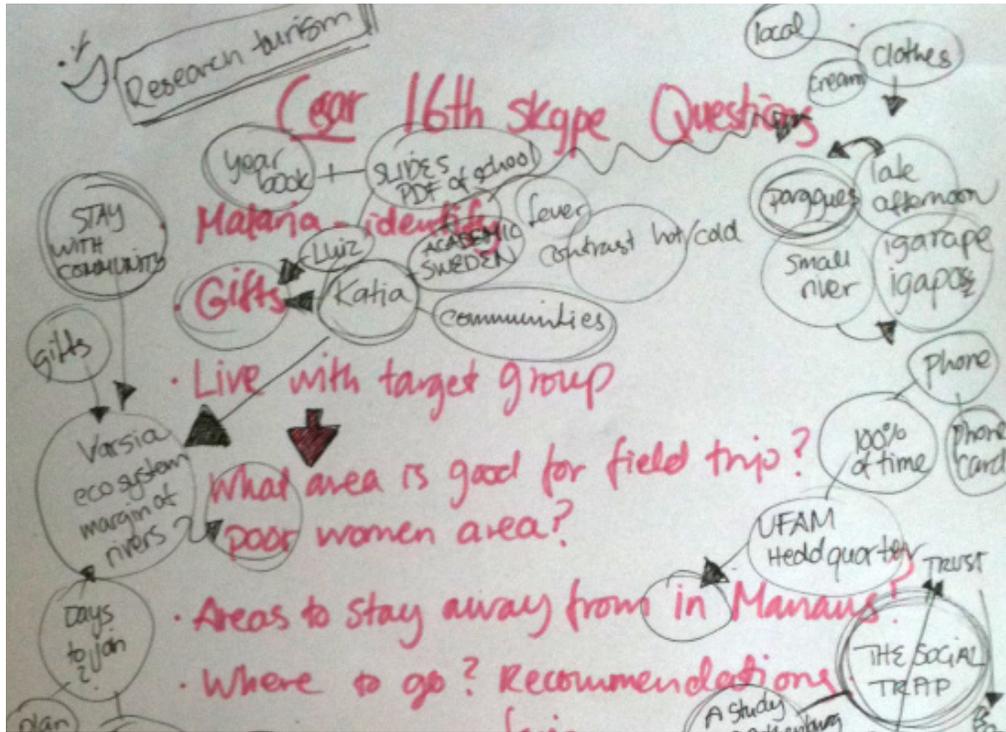


## PREPARING FOR THE FIELDTRIP

Before the trip I was in a really ambivalent feelings. On one hand, it means I will be in the Amazon soon for so many things I have not known and I was really excited about that. On the other hand, it was a little worry as Brazil and Amazon region was a totally different place to me, different environment, culture, language...Skype meetings with our supporter Andreas and our focal contact Cesar were really helpful as giving us many tips and advices. Also, a lot of e-mails were sent to University and Unicef in Manaus to organize our fieldtrip schedule.

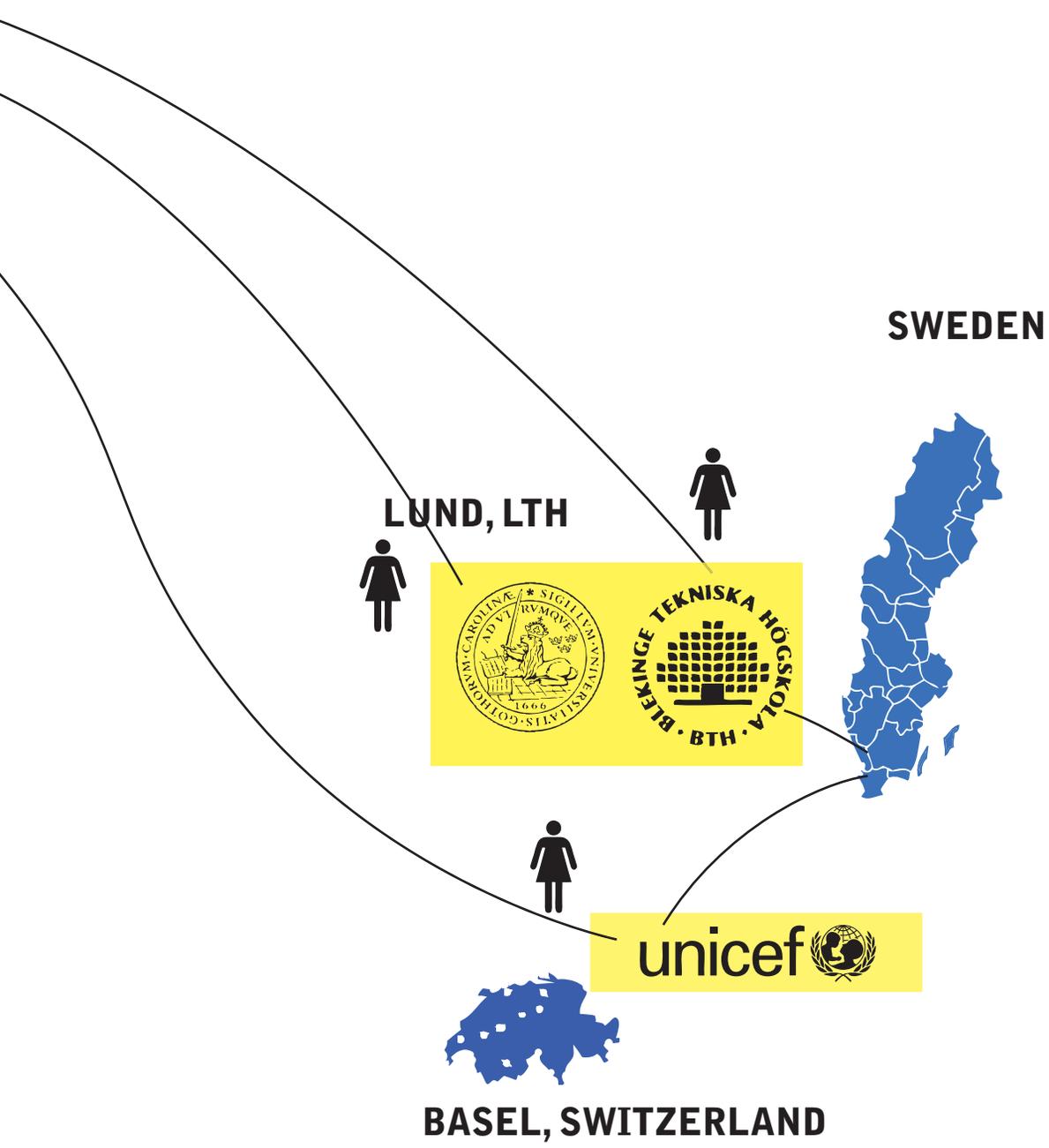
A lot of time also has been spent to learn about the region, the people and the culture as well as brainstormed about the projects targets to narrow down my focused areas in order to make the trip more insightful. By mapping the different life situations I can analyze and choose the target group where I could make big possibility in helping and changing the lives of people.

I understand that getting into the field is the only way to truly understand the BOP markets. Experience locals first-hand, and well-designed experiential learning is the best way to challenge core assumptions and beliefs. I believe in listening to the stories the locals, not assuming I know something. So I decided to bring with me only an open mind and a big willing to try everything...



NETWORKING







# CHAPTER II: THE FIELDTRIP TO AMAZON RAINFOREST



## MANAUS

### A MODERN CITY IN THE HEART OF RAINFOREST

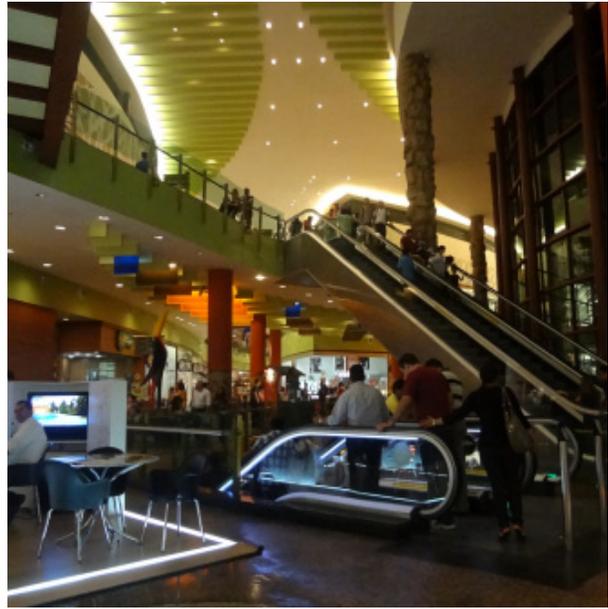
Manaus is the commercial centre of the Amazon region with a population of almost two million. The city looks much like other modern cities on developing. Rows of impressive skyscrapers tower above busy downtown streets, and streams of cars and trucks jam wide expressways at rush hours. Elegant stores and restaurants attract crowds of customers. Sleek, new high-rise apartment buildings stand on broad avenues and contrast sharply with old houses that line narrow, winding streets.





Manaus is the capital of the Amazonas State in the North Region of Brazil, where the Amazon Forest is located. Manaus became a famous city in the late 19th and beginning of 20th century due to the rubber boom (based on rubber production and shipment for decades). With the growing exposure of the Amazon Rain Forest abroad, Manaus became a natural gateway to the Amazon.

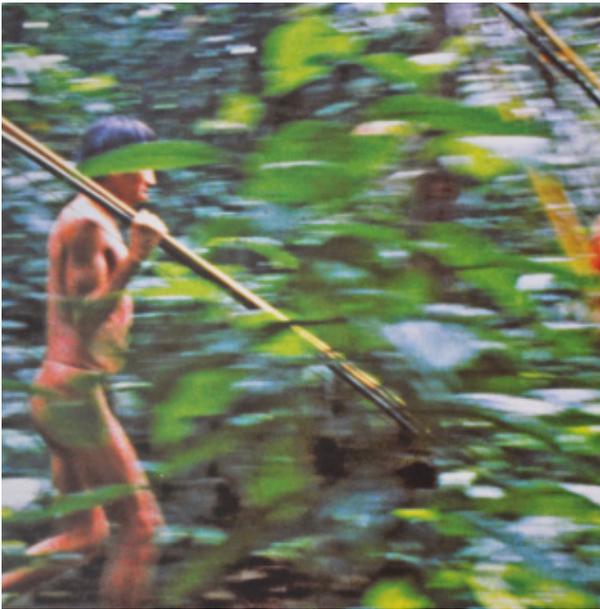
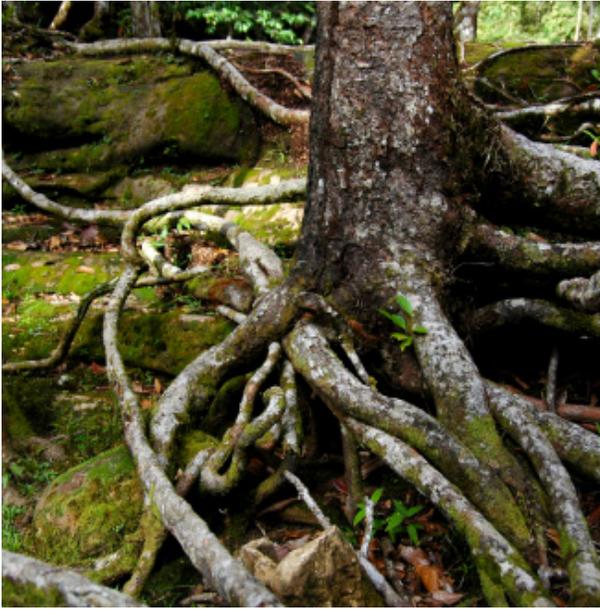
Manaus, Brazil, emerged as an important port city in the nineteenth century during the rubber boom. Today, with more than 1.7 million inhabitants, it is the largest city in the Amazon Basin. It is located on the banks of the Rio Negro (darker, to the left) at that river's confluence with the Amazon River (lighter, to the right). Although it is 1450 kilometers upstream from the Atlantic Ocean, Manaus remains an important port city for oceangoing vessels. It currently exports rubber, Brazil nuts, lumber, and various fruits. Recent discoveries of oil and manganese (used in steel production) may further invigorate its economy. Surrounding this city for hundreds of kilometers in all directions is dense rainforest. Because there are no bridges spanning the rivers in the vicinity of Manaus, ships are used to transport goods across these rivers.



## THE RAINFOREST

It is estimated that approximately 60 million indigenous people are almost wholly dependent on forests. 350 million people depend on forests for a high degree for subsistence and income, and about 1.2 billion people rely on agroforestry farming systems (World Bank 2004). These people lack the basic necessities to maintain a decent standard of living: sufficient and nutritious food, adequate shelter, access to health services, energy sources, safe drinking-water, education and a healthy environment. In adopting the Millennium Development Goals (MDGs), the countries of the world have set a target of halving global poverty by 2015. Given the importance of forests for the rural poor, it is recognized that forests can be a resource for poverty reduction. The protection of biodiversity is essential in the fight to reduce poverty and achieve sustainable development.

During the fieldtrip, with the kind help of UNICEF, we did try to visit indigenous villages, unfortunately it was not easy as we thought due to some strict policies. We had to turn back when we were almost reaching the indigenous community. However, we got chance to visit some eco-shops selling handcrafts and clever traditional products made by indigenous people with really high skill and aesthetic mind. Very inspirable!



An aerial photograph showing the confluence of two rivers into a larger body of water. On the left, a dark, almost black river flows into a larger, muddy brown river. The muddy river then flows into a vast, wide expanse of light brown water. The surrounding landscape is lush green forest, with some buildings and infrastructure visible along the banks.

*“meeting of waters,” where the muddy, brown-coloured Solimões waters meet the black Negro waters to form the Amazon River.*

## **RIO NEGRO**

- The color is the color of black tea due to humic acid
- Less nutritious and "poorer" compared to Solimões
- Sandy bottom
- The width of the river differs up to 30k depending on flood/dry season



## RIO SOLIMÕES

- Contains a vast quantity of sediments eroded from Andes mountains ●
- Provides nutrient-rich mud to lakes on the floodplain ●
- It is shallower than Rio Negro due to the sediments ●
- Rich on animals and fish ●

## RIO NEGRO



Because of those differences in character of two rivers, people who live along Rio Negro and Rio Solimões have different conditions for living. For example, the main source of income for people of Rio Negro are from Tourism and Traditional handcraft, etc.

## RIO SOLIMÕES



While for people of Rio Solimões their living are mainly based on agriculture. Anyhow, the Amazon river plays an vital role in riverine communities.



The people who make their living along the middle Amazon today are known as caboclos. The term caboclo conveys different meanings to different people, in the colloquial use, caboclo can be a racial category, economic class, or rural resident. In elementary school, Brazilian children learn that caboclo means a mixture of Amerindian and European ancestry. Caboclo also indicates a low social class, the rural or urban poor, and illiteracy. In the academic literature, caboclo is not a racial category but rather, a social category, the indigenous Amazonian peasantry. (MORGAN J. SCHMIDT, 2003)



## AREA IN FOCUSED - VÁRZEA

The Brazil Amazon floodplain or Várzea, is one of the world's most important and dynamic ecosystems, is a land of mysteries. The fertile soils and abundant fish of the Várzea have sustained local people for generations, and are vital to the economy of the Amazon region.

Riverine communities live on a floodplain that annually undergoes drastic environmental change. The river is their life and is used for washing, bathing and fishing, and the water for cooking, the river is also their main way for transportation.

Farming is the major focus, but fishing, hunting, extraction of forest products, and waged labour are also integral economic pursuits of the river people. Each activity has distinct pattern throughout the year, involves different members of the household, and fulfills specific purpose in the household economy. Largely invisible activities are carried out by women and children, and contributes significantly to riverine household protein intake.

Most of people in the rural of Amazon region depend heavily in natural resources for everyday living, some others have their own small scale family farm, they work hard under poor condition and earn little money and can barely access to good services or products supporting well-being and working. Poverty and lacking basic needs still are especially widespread in the rural of the northeast.

The floodplains of the Amazon host a significant number



of marginalized small- scale family farmers who lack commercial crops which could insert them in markets and are thus situated outside the dynamic farm sector of Brazil. The floodplain environment imposes serious restrictions for commercial production in terms of appropriate crops and technical practices. Like other rural regions in developing countries, small- scale family producers in Amazon river have to fight hard to keep afloat in an economy that always bias toward large growers and big farms.

With the evolution in thinking about the importance of rural development and poverty alleviation has come growing interest in how small scale family productions can contribute to households and livelihood security. Should an innovation that enable the riverine farmers to significantly reduce production costs or increase productivity, while protect the treasured resources and move small- scale rural families to a more sustainable way of farming and production?





## **FIELDWORKS**

Thanks to the extraordinary help of Professors and friendly students in UFAM, we got chances to access closer to the daily life of local people in different types of Amazon riverine communities: high floodplain village, low floodplain village of the Rio Solimoes and a high floodplain of Rio Negro. Where, out of expectation, we have learn a lot about the life, culture, languages, the constraints and opportunities which are definitely valuable for our researches.

# SANTA LUZIA COMMUNITY

## A HIGH FLOODPLAIN VILLAGE OF THE RIO SOLIMÕES

Santa Lucia community is located in the high floodplain of the Rio Solimões where less suffers from the flooding during the winter. Since they can maintain a more sustainable agriculture and living, this community is quite wealthier than other Vázera of the lowland.

We experienced a workshop to paint on jute fabric together with the women organization within the village. The workshop was organized by a Professor in UFAM. She has been carrying out a research project about this community for over 4 years.





Some photos of the village with the aim to transfer a basic and general image of the life here.



A workshop to paint on jute fabric. The painting then will be made hand bags for selling to raise fund for the women organisation of the village.

## NOVO AIRÃO

### A HIGH FLOODPLAIN COMMUNITY OF THE RIO NEGRO

The Rio Negro is the largest blackwater river of the world. Specialists characterize these waters as being extremely acidic and poor in nutrients. The soils that they drain are usually greatly impoverished by leaching.

The income sources of people along the Rio Negro River mainly not based on farming. There are many types of activities to serve the tourists for example river dolphin seeing, river tours, restaurants, etc.

In the village we visited there are several factories of traditional hand craft. The organization takes care of education and production regarding wood carving, recycling paper and horticulture.









## NOSSA SENHORA DAS GRACAS



I did my actual fieldwork in this village. Johanna and I went to the community by car with one of the UFAM students. We had to cross the river by boat and started out our fieldtrip by visiting the school. We had created some games to teach English. It was a wonderful experience for us and very challenging since we don't speak Portuguese and the children don't speak English.

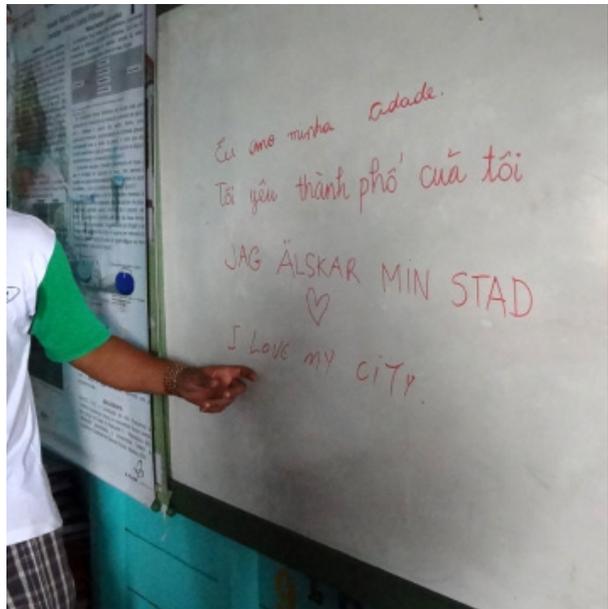
With cameras and film cameras I documented everyday life and tried to record everything I saw in written or illustrated format. I tried to focus on the fields of interest that I looked closer into the situations. There were countless conversations with local people, and I listened to their stories with the help of a UFAM friend for translating.

In the village we lived together with the grandmother to the two teachers. We slept on hammocks, we ate local food, drank river water directly...We tried to extract jute, make farinha, swim in the muddy river, paddle on a swamp/lake...and take part in the everyday life. It was a beautiful experience!





Some photos of the village with the aim to transfer a basic and general image of the life here.



Some photos from the English workshop with local children.

## FIELDS OF INTEREST

In Amazon floodplain communities, and the village where I did my actual fieldwork particularly, JUTE FIBER and FARINHA are the most important sources in small scale family production, that provide inputs and income directly to huge numbers of rural households.

Seasonal flooding on rich alluvial plains permitted the introduction of JUTE for fibre production in the mid- 20th Century while MANIOC has been one of the most important staple crops in the Amazon for thousands of years, however there have been few studies of their cultivation and production.

Processing methods for JUTE FIBER and FARINHA still similar like centuries ago which required a lot of time and labour work in the poor conditions, however giving low productivity and high product losses. There is a great need for development of improved processing methods for JUTE FIBER and FARINHA.

Understand the economic potentials and constrains in producing JUTE FIBER and FARINHA. I decided to choose these two areas for my further research with the purpose is to understand the situations and identify solutions for improvements.



SMALL SCALE  
PRODUCTION





Jute, a fiber crop, dominated agricultural production along the Amazon River floodplain in the reach between Manaus and Santarém, Brazil, from the late 1930s until the early 1990s. The crop was introduced to the region by Japanese immigrants. Local smallholder cultivators grew and processed jute, production being mediated initially through Japanese middlemen, later by Brazilians. Poor fiber quality, several external shocks, including the removal of tariffs on imported jute, and especially changes in commodity packaging such as bulk handling and the use of synthetic sacks instead of jute sacks for the transport of coffee beans, the Amazonian jute market collapsed in the early 1990s. Despite its collapse, the legacy of the boom is still evident in the physical and social landscapes in the region. In recent years natural fibre production has taken on considerable appeal because of new industrial applications in environmental friendly products and growing demand for fibres could contribute to social welfare of poor farmers in developing countries. The new uses of natural fibres are part of highly technical green solutions for problems in the industrial and consumption regions. New demand for natural fibre today opens a potentially promising avenue for economic opportunity for Amazon riverine farmers, building the great commercial products of riverine Amazonas.

In recent years, however, the agricultural- industrial chain using natural fibre is expanding and fibre production is increasing again, particularly in Amazonas state. Fibre cropping is starting to spread further up and down the Amazon River and the number of farmers involved has passed

9,000. Prices received by farmers have also improved, from R\$0.51 per kilogramme of fibre in 2000 to R\$0.73 in 2002 and R\$1.11 in 2006 (R\$1=US\$0.47 in 2006). Further expansion is a distinct possibility because the market for natural fibre has great potential for national and global growth and different levels of government in Brazil, especially within the region, have been keen on stimulating the production of natural fibres for new industrial applications.

But what is the social significance of renewed fibre production? Will the small scale of production reach the point that a large number of peasant farmers will be integrated in such a way as to improve their income and quality of life? There are already 9,282 family farmers planting jute and malva, which is a significant number, but still well below the historic figure. The number of farmers involved has increased and they were drawn to the possibility of earning an income, but is it a dignified income?

Compared to basic food production in riverine areas, fibre cropping generates more income and involves less work. Basic food crops grown are beans, maize and manioc and only manioc in the form of meal has a market but requires a large labour input and the price is comparatively low. Fibre is highly adaptive to floodplain environments and is also cheap to produce because it does not require agro-chemical inputs so that this kind of cropping is accessible to poor farmers and does not cause soil and water pollution.



## PROBLEM ANALYSIS

Poor working conditions represent another problem for renewing fibre production and work ecology constitutes an important dimension of environmental sustainability. A common complaint among interviewed farmers was the long hours spent in the water processing jute and malva. A good deal of the work, which is almost all manual, is undertaken in the water. During harvest the stalks are cut and soaked in the water under the sun for six to eight days. After this, fibre is manually removed from the stalk and then is put to dry on lines and re-bundled for classification and sale.

At the primary production end of the natural fibre economy, a good deal more social responsibility is called for than merely thinking in economic terms of production because farmers still earn low income, face bad working conditions and have a poor quality of life in general.

New crop methods attuned to better working conditions must be introduced and income and quality of life must be improved or else the firms touting the environmental friendliness and social responsibility of their products are just engaging marketing tactics to sell to green consumers at the same time that farmers remain in poverty.





Cassava is an edible root originating in western Brazil and one of the most consumed foods in the Amazon region, which concentrates a large number of flour mills. Cassava also is grown widespread in the hotter lowland and the tropics. Because cassava grows fast and easy, has large yields even in poor soils and is little affected by diseases and pests, in developing countries, cassava is one of the most important security crop and main source of energy. Cassava roots develop radially around the base of the plant forming five to ten tubers per plant.

Cassava is today a primary calorie source in tropical regions around the world, and the third most important crop plant worldwide. Once a subsistence crop, cassava is now grown primarily as a source of income generation, either by direct marketing of cassava products, or by adding value through on-farm animal feeding.

In the Amazon basin, density of agricultural exploitation is very low, but cassava is the principal crop in areas of traditional agriculture. In all these regions, cassava contributes significantly to dietary calorie intake and to farmer income.



## FARINHA

Throughout centuries cassava roots have been processed into a type of flour called 'farinha de mandioca', this end-products of cassava is very common and used as a basic staple food, especially in the rural communities in Amazon region. 100g Farinha contain 1,7g proteins and 86,4g of carbohydrates, the fiber contain increases almost two fold: 1,8g in every 100g of Farinha.

The consumption of cassava in Brazil is higher in rural areas where it is consumed in two principal ways: as cassava toasted flour (farinha), the most important consumption product, and as fresh cassava. In the Amazon region, Farinha is the most important source of calories, with a percapita consumption of 43.7 kg of flour, while the Brazilian per capita consumption of flour is only 17.6 kg

In addition, Farinha, represents one of the most important sources of income for farmers. However the irregularity of precipitation so characteristic of that region, gives rise to oscillations in cassava production, influencing the price of cassava flour and, consequently, farmers' incomes. Besides, the low quality of the product and low processing technology, contribute to the establishment of commercialization systems into which the farmers usually sell their products for prices lower than production costs.

One family with 5 labours working together can produce about 150kg farinha per week, just enough for family consumption. But sometime, they put some bags in the market with the price from 35 Reais to 50 Reais per bag 50kg



# CASA DE FARINHA





## FARINHA PRODUCING

Farinha is produced in Casa de Farinha - House of Flour, in which techniques and equipments are quite similar to those have used for centuries. The Amazon's casa de farinha usually locates annex to the proprietor's home, made of wood and local clay and women spend most hours of the day processing the cassava.

There are several processes that make the flour is what is inside the package, or on the tables. The production of farinha requires a time consuming and labor intensive process in order to transform the raw material, cassava roots, into the finished product. An average family of six producers approximately 50kg Farinha per month, this quantity requires about 400 cassava roots.



Traditional processing to make farinha from start to finish will take a couple of days, includes six steps: Peeling, Washing, Grinding, Drying, Sifting and Frying.

- First, cassava is peeled to strip off the skin of the roots.
- Then the roots must be soaked in the water for about one day to release the poisonous.
- After that the roots will be grinded to manioc mash.
- The ground manioc mash still contain a lot of moisture, so it will be pressed out all the liquid until totally dry.
- The next step will be sifting the paste in order to separate fibers.
- Finally, is frying the farinha, it will take around 1 hour and a haft to finish one batch.

PEELING



SOAKING



GRINDING



PRESSING



SIFTING



FRYING



## PEELING CASSAVA

Peeling which is defined as "to strip of the skin" is an important operation in the processing of any tuber or root crop. The cultivation of cassava requires minimal input, but the processing of cassava roots is laborious and time consuming. The varying shapes and sizes of cassava tubers have made cassava peeling to be one of the major problems in the mechanization of cassava processing.

In the village, the cassava peeling is still totally done manually with knives to remove the thick outer layer of the tuber. Women and children are mainly take responsibility in this job. This is often time wasting, energy consuming and labour intensive which invariably leads to low productivity. That the reason there is a need for the peeling cassava to be done mechanically.



## SUMMARY & CONCLUSION

The production in Casa de Farinha now is still similar to those happened centuries ago, that is almost handmade with old traditional techniques and equipment and take a lot of time as well as physical labour. One of the major challenges is peeling cassava. The peeling process traditionally takes three to four people utilizing only a standard kitchen knife. In the family scale of producing Farinha, cassava is totally peeled by hand. This hard and tedious job has low productivity, high product losses, high time consuming and labour...and mainly responsible by woman and children.

Since then there is a need to improve the methods of peeling cassava and develop an effective cassava peeler.

Moreover, the step of peeling chosen for concentrate is selected based on the high requested from people in the village where we researched and also since I found my ability to make a significant improvement in this area.

That the reasons I will now further my brief to focus on improving working conditions in the Casa de Farinha, aiming to support rural families by encouraging alternative and sustainable production activities. Also consider about the limited electric source and high cost of running by gas, my idea is to design a mechanical cassava peeler that help to increase the productivity in peeling cassava, reduce product losses, time consumption and physical labour power.

The primary objective of the project is to develop a ma-

chine capable of peeling cassava. this machine should reduce processing time and labour required for peeling. the machine also should be able to reduce product losses, and finally, the machine should be durable, easy and safe to use, and affordable to low class families Especially fitting the local economic and socio- culture without expanding current environment resources.

My ambitious in this project firstly is to improve the quality of working condition for women labourers in family scale production by providing more efficient, economical methods for cassava processing. The goal of the project is to design, fabricate and test a cassava peeling machine that is capable to lower income people in amazon region.



**CHAPTER III:  
A PEDAL POWERED  
CASSAVA PEELING MACHINE**

## ABRASIVE PEELING TECHNIQUE

Cassava tuber is white or cream or light yellow in color and generally are surrounded by 2 layers of skin: the outermost cambium layer - Periderm, and the soft Cortex layer beneath the Periderm. For food using, the Periderm and Cortex layer must be peeled out completely. Normally, there are two types of Cassava are using widely in the Amazon region: the one with white starchy flesh and the one with yellow starchy flesh. The yellow-starchy-flesh cassava is poisonous and used to make Farinha. In order to get rid of poisonous, people have to soak it in water for several days and then have to press out all of the water. According to people in the village, although the skin of the yellow-starchy cassava is softer than the white-starchy one, and is about 2- 3mm thick.

Since the skin of cassava is tougher and thicker compare to other kind of roots (like potatoes, carrots...), the techniques for peeling cassava also need to be suitable. There are a number of methods in peeling cassava has been developed around the world. Mechanical, Chemical or Thermal methods are currently in use by devices, caustic solutions and heat respectively. Every method has different advantages and limitations on the basic of technique used. Although mechanical method has high losses and low flexibility, it is still preferred among current methods because it maintains freshness of edible portions of product and does not damage tissue (Bagher Emadi, Vladis Kosse, Prasad Yarlagadda - 2005).

However, due to the varying in shape and sizes, the thickness of skin and uneven surfaces of the cassava root, mechanical abrasive technique is considered as the best

solution and commonly used by medium to large processors and is highly advanced.

Most of the machines in the market or has been developed usually found in the shape of cylinder or rollers with the inner wall of cylinder or outer layer of rollers is covered by abrasive carborundum. The contact between roots and coated layers accompanied by movement of one of them, lead to peeling action. (Bagher Emadi, Vladis Kosse, Prasad Yarlagadda - 2005).

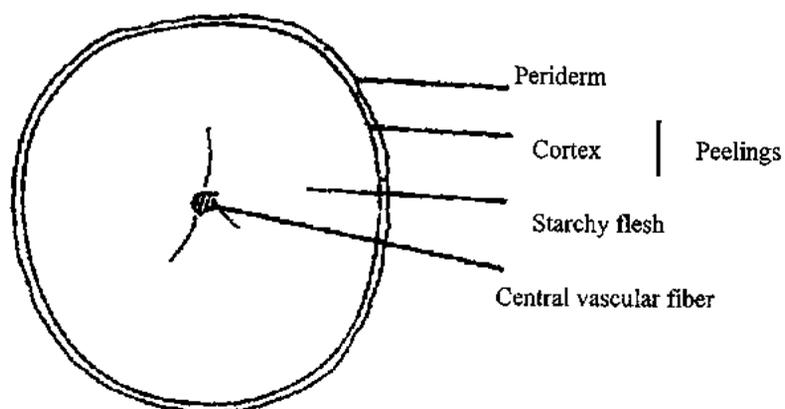


Figure 1.1 General view of a cassava root (Onwueme, 1983)

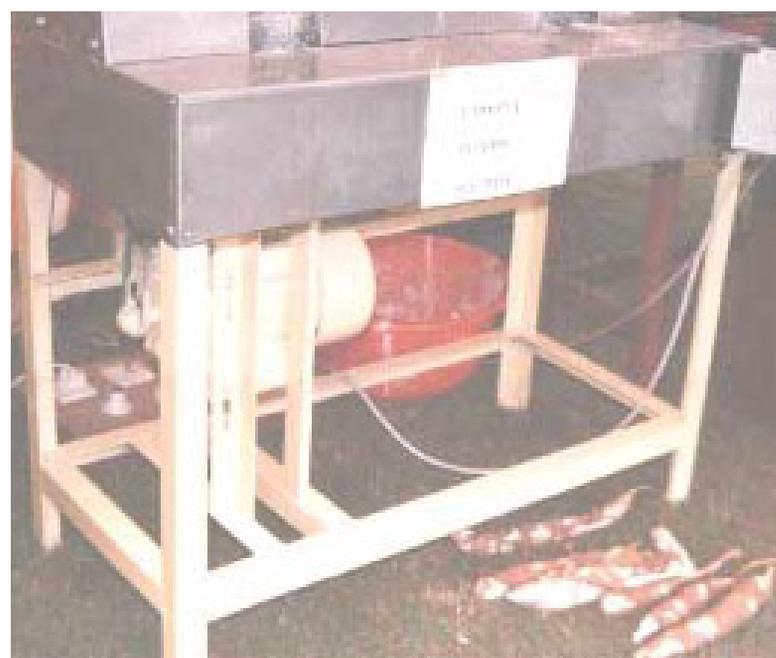
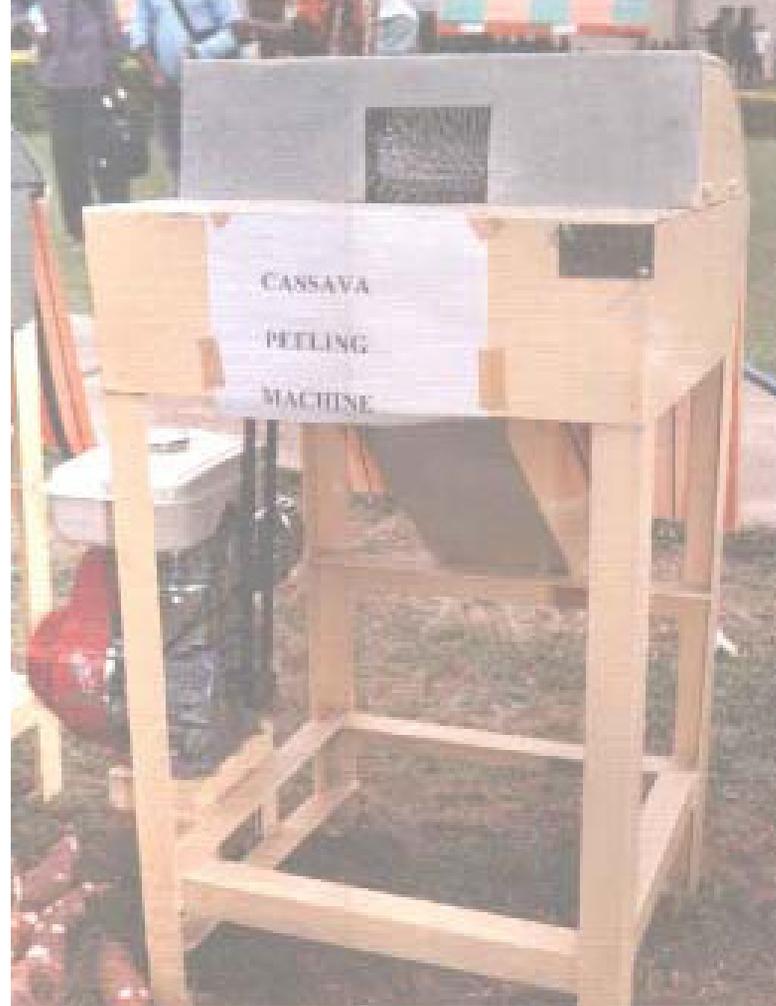
## EXISTING LOW-COST MACHINES

A number of lowcost peeling machines have been developed include the following: a continuous process cassava peeler developed by Odigboh (1976). It consists of a cylindrical knife assembly and a solid cylinder, mounted parallel and 20 cm apart on an inclined frame. The machine was reported to have very high efficiencies, over 95%, when handling lots of even sized cassava tuber pieces, but had lower efficiencies, about 75%, when peeling mixed sizes of cassava tubers.

Another peeler, a batch process cassava peeling machine was developed by Odigboh (1979) and later modified (Odigboh, 1981). In this modification a cylindrical drum with abrasive inner surfaces was eccentrically mounted on a shaft and the eccentric movement of the cylinder causes the tuber to rotate and tumble thus peeling the tubers.

Sheriff et al (1995) evaluated a cassava peeler developed at the Tamil Nadu Agricultural University (TNAU) where tubers were fed into the peeler through a feed tray. As the rotor shaft rotates, the cutting blades mounted along the circumference of the rotor scrapes off the tuber surface. The peeling efficiency and flesh loss were 50.64% and 15.87% respectively.

At the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, the integrated cassava project initiated a search for an effective cassava peeler in 2005 in conjunction with the Federal University of Technology, Akure, which started a conscious and desperate search for effective cassava peeling machine in July, 2004. This effort resulted in the production of commercial models of the single and double gang hand fed cassava- peeling machines (O.J. Olukunle et al.:The Research for an Effective Cassava Peeler).



Many other low-cost machines for peeling cassava which are already done or on development that obviously have major advantage in eliminating of manual intervention during the peeling process. However, most of these machines are running by electricity or petrol engine that lead to the high cost of producing for small-scale producers. Moreover, those machine just can obtain low capacity with efficiency is generally less than 80% and losses are more than 8%.



EXISTING HIGH-TECH SOLUTIONS



One of the most high-tech machine for peeling cassava is the STAINLESS STEEL AUTOMATIC CASSAVA PEELING MACHINE. This machine adopts the advanced principle that the rollers make roots inside roll. The rollers are made of ABS95 plastic, so the brushes are easy to exchange. The main parts adopt double bearings. The chain and chain wheel are durable. Run by electricity with the capacity about 1000- 2000kg/hour, high efficiency and low flesh loss, the machine has the price range from US\$1,750 - 5,400 depends on the size and the capacity of the machine.

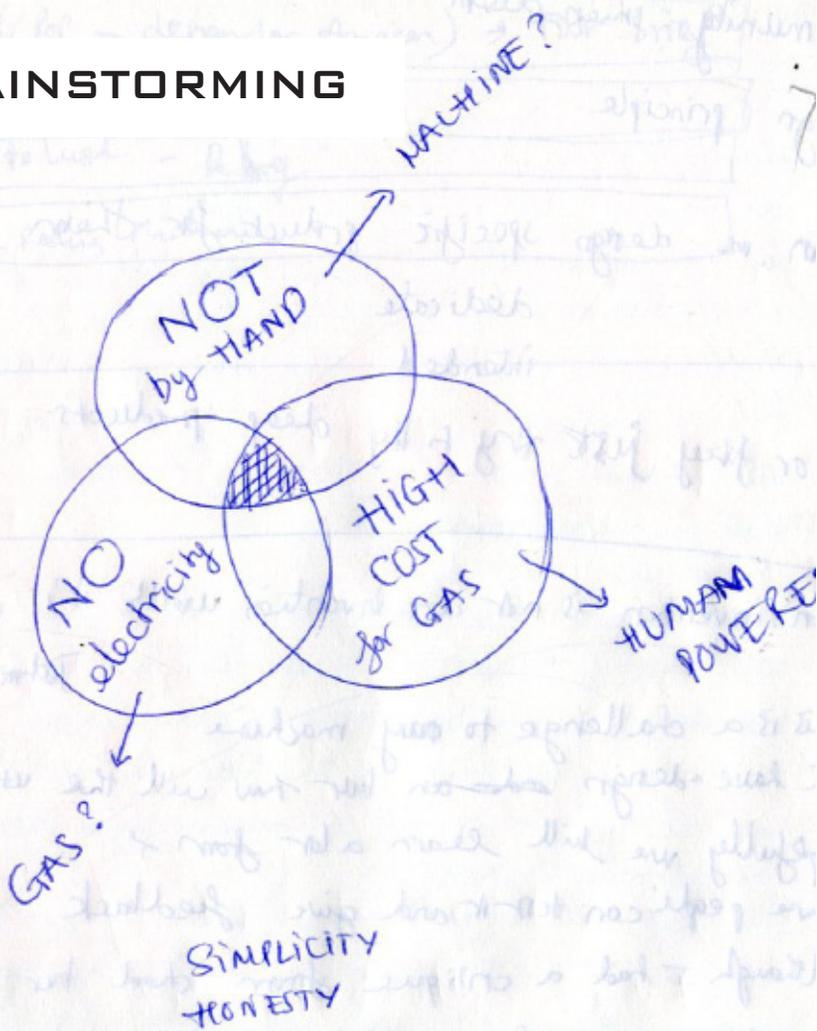
High cost of most of the machines, cost of maintenance and services were constraint to acquisition of the already available machines in the market. Maintenance and service culture of most of the processors were poor and this affected the durability of the machines.



**“WE REFUSE TO ASSUME THAT EVERY PROBLEM  
HAS A HIGH-TECH SOLUTION!”**

**– LOW-TECH MAGAZINE**

# BRAINSTORMING

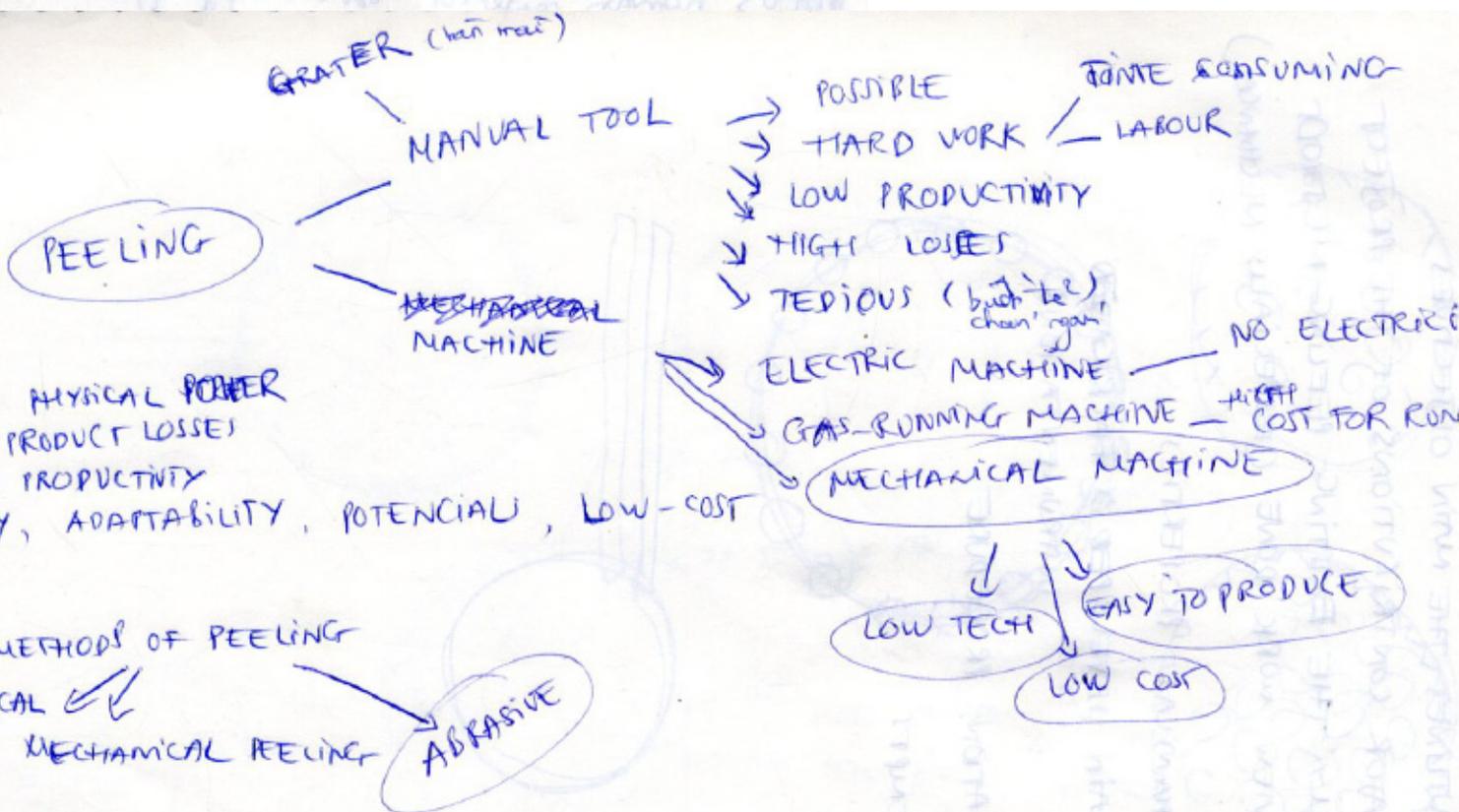


What can be financially viable?



FARMING TOOLS  
TECHNOLOGY THAT BOTH APPROPRIATE  
⇒ INCREASE THE QUANTITY  
& PHYSICAL DEMANDS OF  
WOMEN'S CROP PRODUCTION

## CONSTRAINTS & POTENTIALS



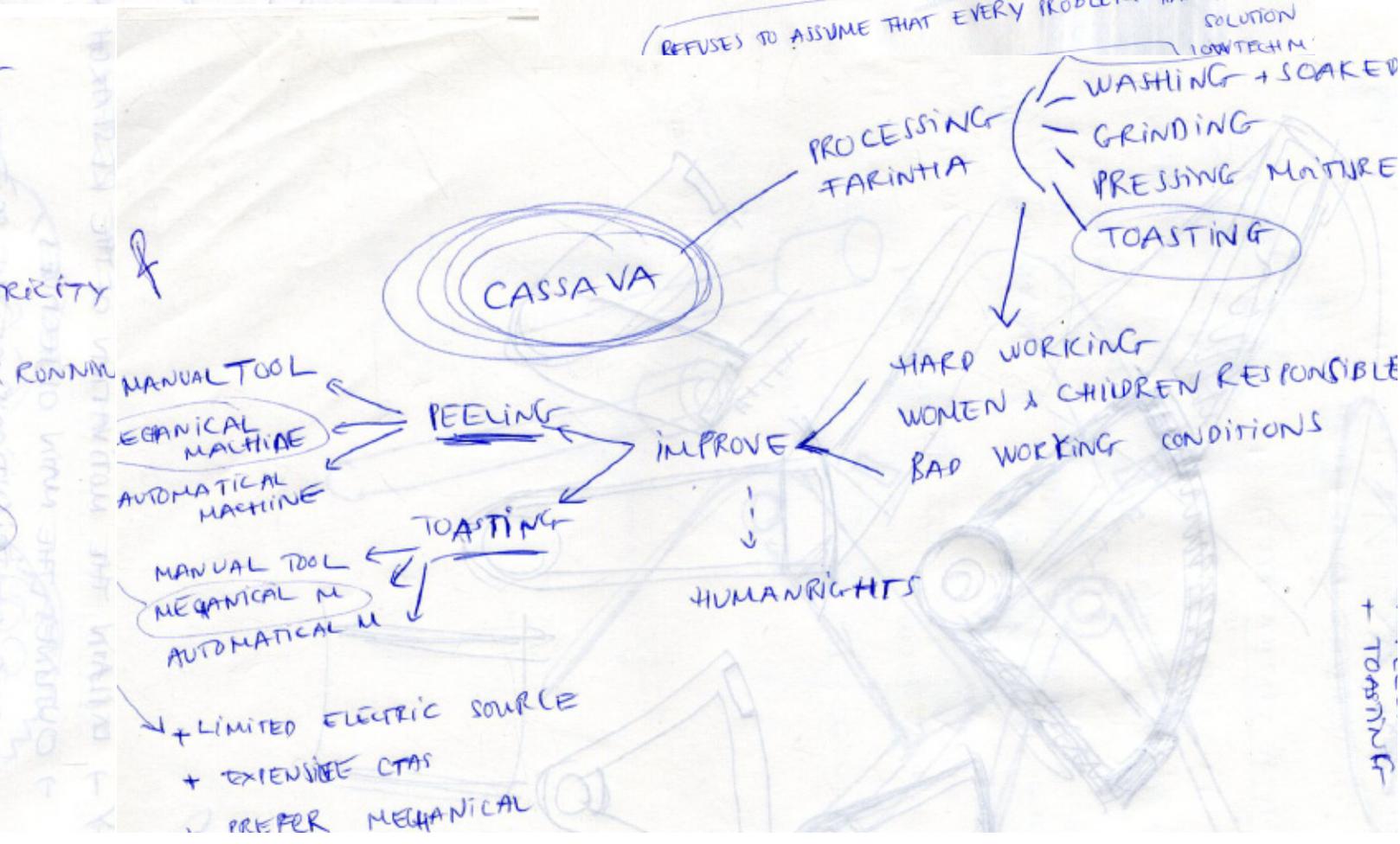
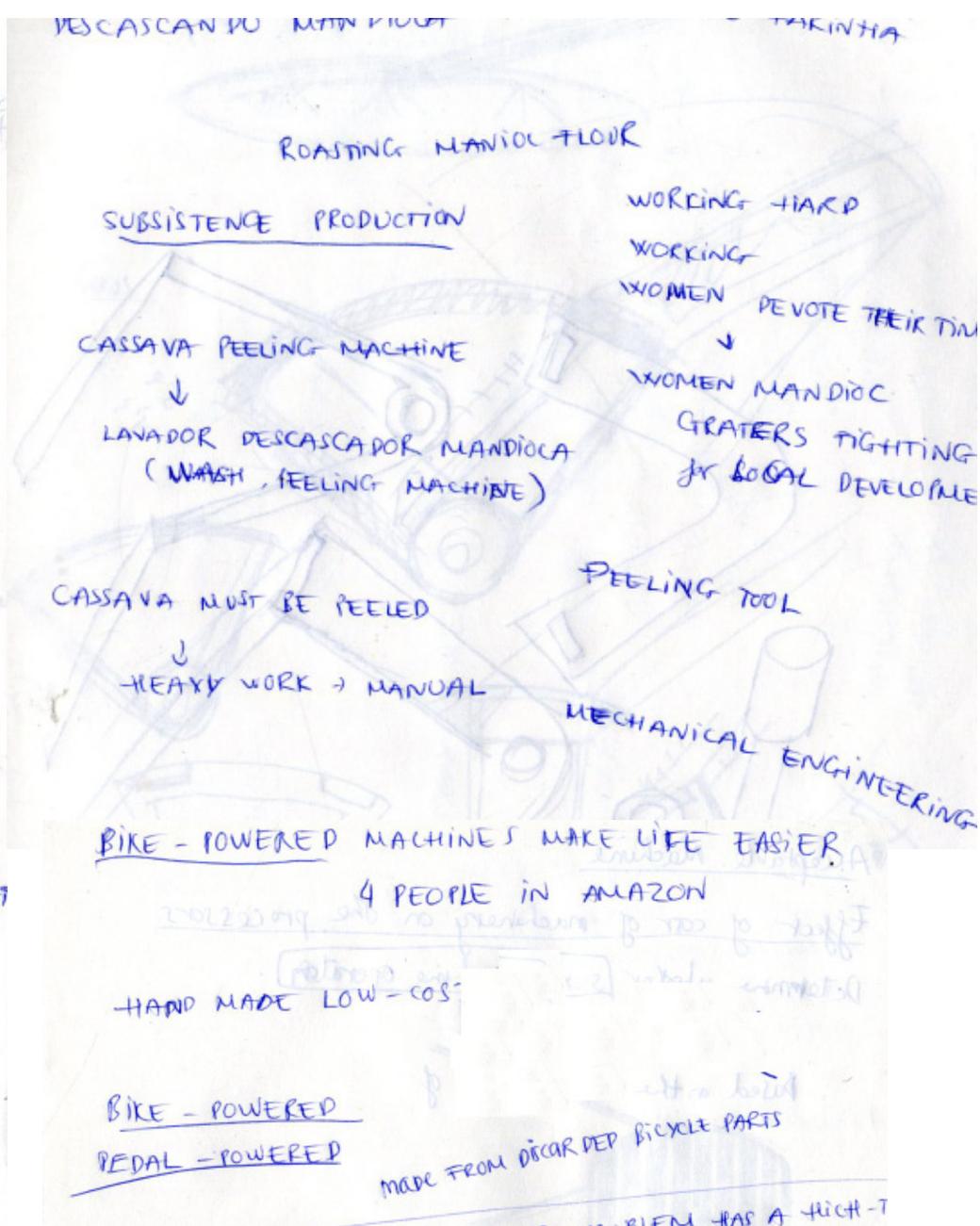
What people desire

FEASIBILITY

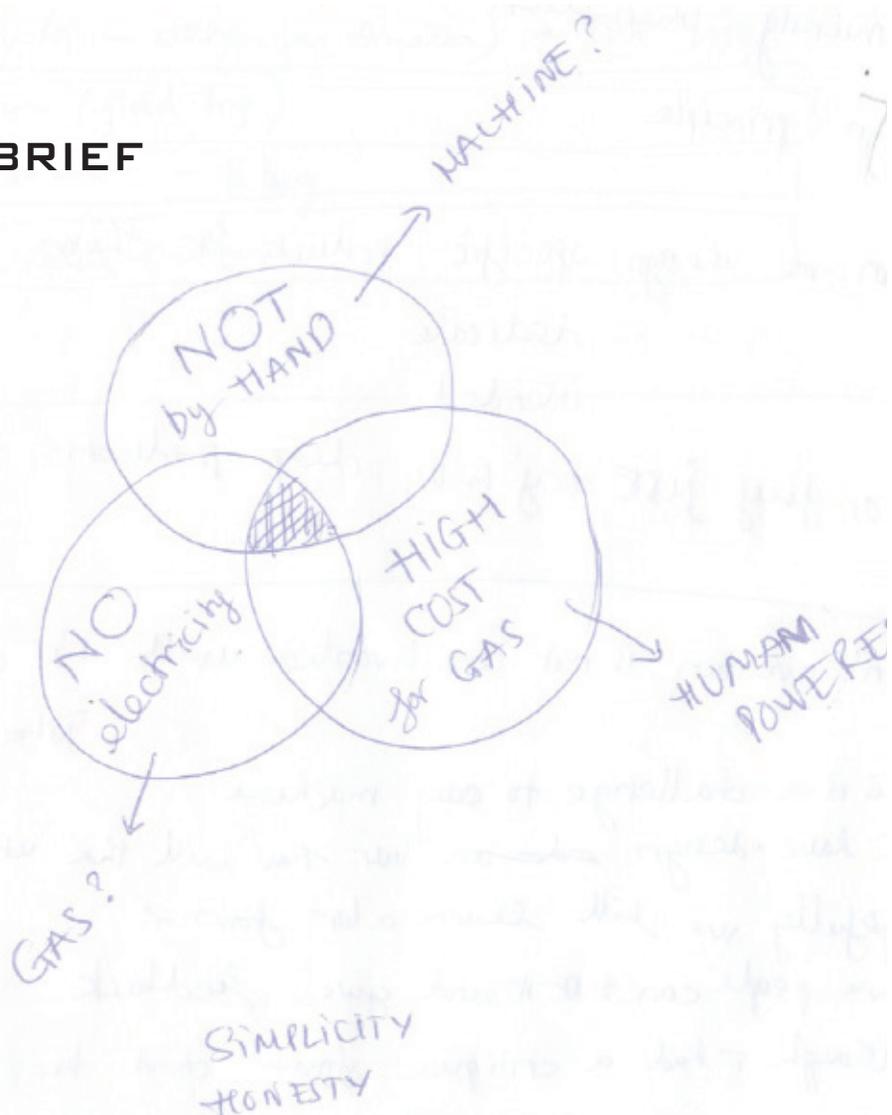
What is technically & organizationally feasible?

PROPRIATE FOR WOMEN + ENVIRONMENT SAFE

PRODUCTION ACTIVITIES



**BRIEF**

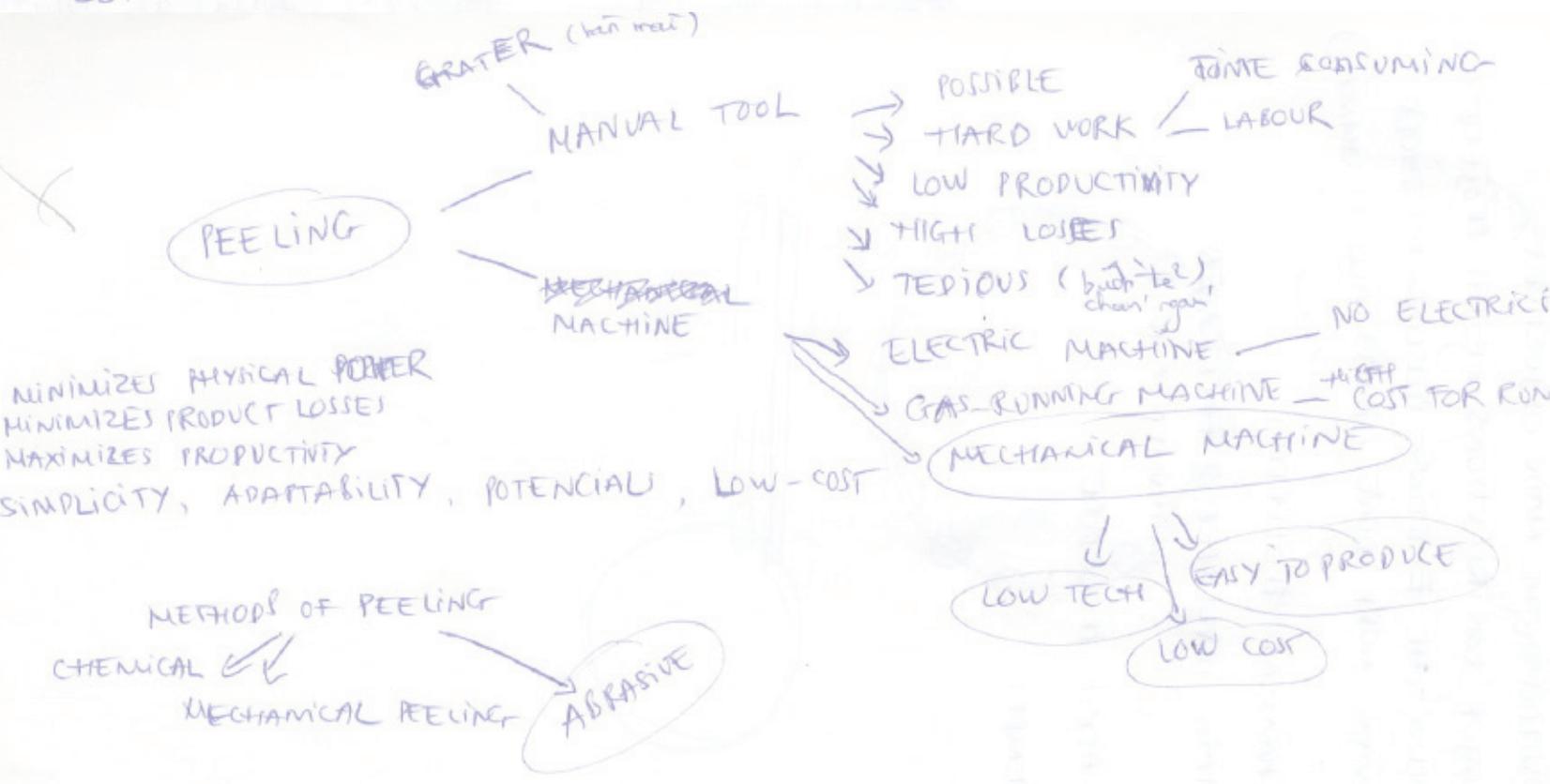


What can be financially viable?



FARMING TOOLS  
TECHNOLOGY THAT BOTH APPROPRIATE  
=> INCREASE THE QUANTITY  
& PHYSICAL DEMANDS OF  
WOMEN'S CROP PRODUCTION

**CONSTRAINTS & POTENTIALS**



do people desire?  
 FEASIBILITY  
 What is technically & organizationally feasible?

DESCASCANDO MANDIOCA

CASA DE FARINHA

ROASTING MANDIOCA FLOUR

SUBSISTENCE PRODUCTION

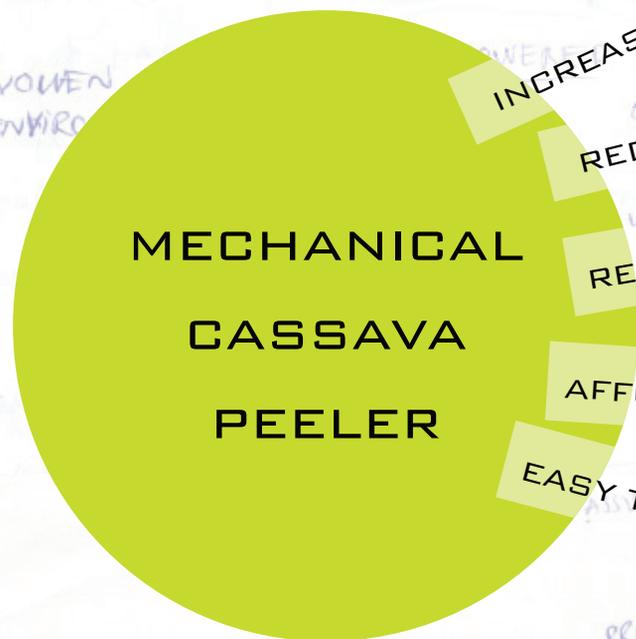
CASSAVA PEELING MACHINE  
 ↓  
 LAVADOR DESCASCADOR MANDIOCA  
 (WASH, PEELING MACHINE)

WORKING HARD  
 WORKING  
 WOMEN DEVOTE THEIR TIME  
 ↓  
 WOMEN MANDIOCA  
 GRATERS FIGHTING  
 FOR LOCAL DEVELOPMENT

CASSAVA MUST BE PEELED  
 ↓  
 HEAVY WORK → MANUAL

PEELING TOOL

MECHANICAL ENGINEERING



INCREASE CAPACITY  
 REDUCE PROCESSING TIME

REDUCE PRODUCT LOSSES

AFFORDABLE

EASY TO USE AND MAINTAINING



PROCESSING FARINHA  
 WASHING + SOAKED  
 GRINDING  
 PRESSING MATURE  
 TOASTING

HARD WORKING  
 WOMEN & CHILDREN RESPONSIBLE  
 BAD WORKING CONDITIONS

IMPROVE  
 ↓  
 HUMAN RIGHTS

MANUAL TOOL  
 MECHANICAL MACHINE  
 AUTOMATIC MACHINE

MANUAL TOOL  
 MECHANICAL M  
 AUTOMATIC M

- + LIMITED ELECTRIC SOURCE
- + EXTENSIVE COST
- + PREFER MECHANICAL

+ PEELING  
 + TOASTING



## PEDAL POWER

Ever since the arrival of fossil fuels and electricity, human powered tools and machines have been viewed as an obsolete technology. This makes it easy to forget that there has been a great deal of progress in their design, largely improving their productivity.

The most efficient mechanism to harvest human energy appeared in the late 19th century: pedalling. Stationary pedal powered machines went through a boom at the turn of the 20th century, but the arrival of electricity and fossil fuels abruptly stopped all further development.

Along with the green energy benefits that pedal power offers, bicycle has proved to be the great ride. Bicycle riding can be a joyous experience, also strengthens the muscles.



## TESTING BRUSHES

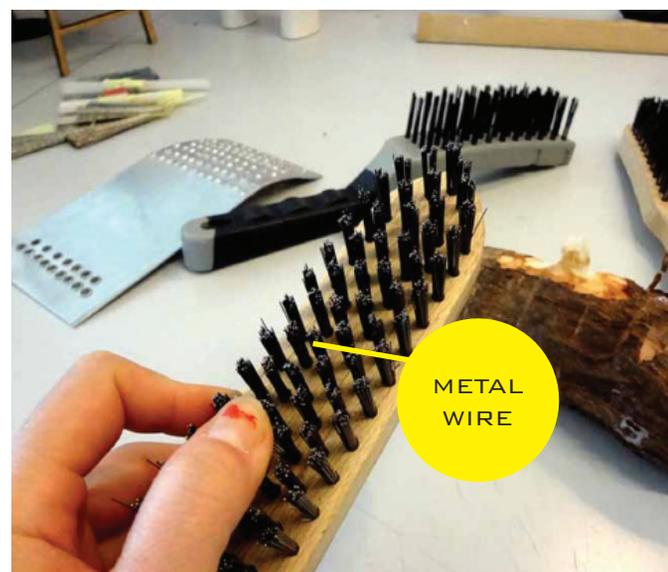
Got inspiration about using brush to peel cassava. I made a test to try out many kinds of brush.

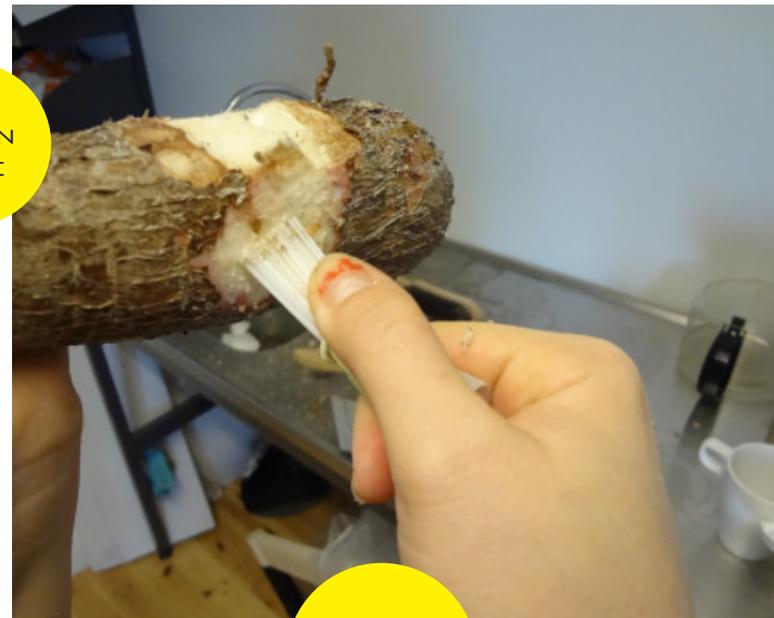
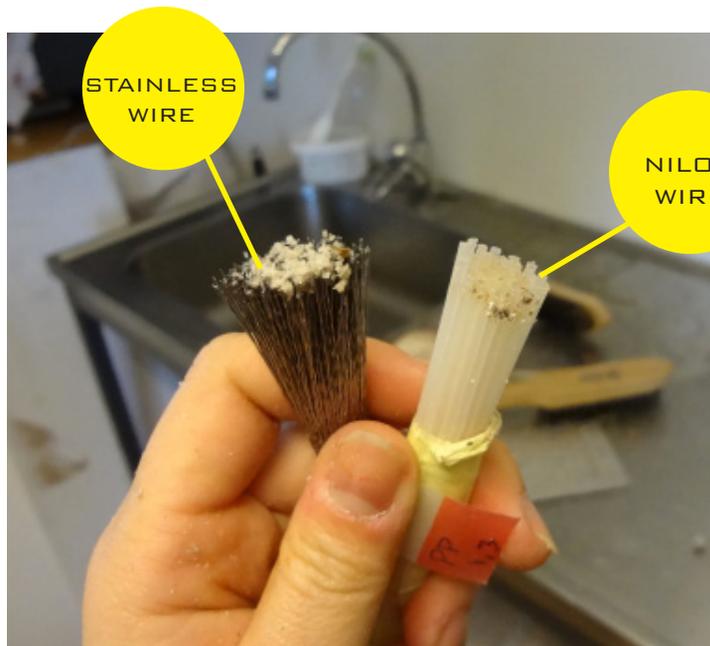
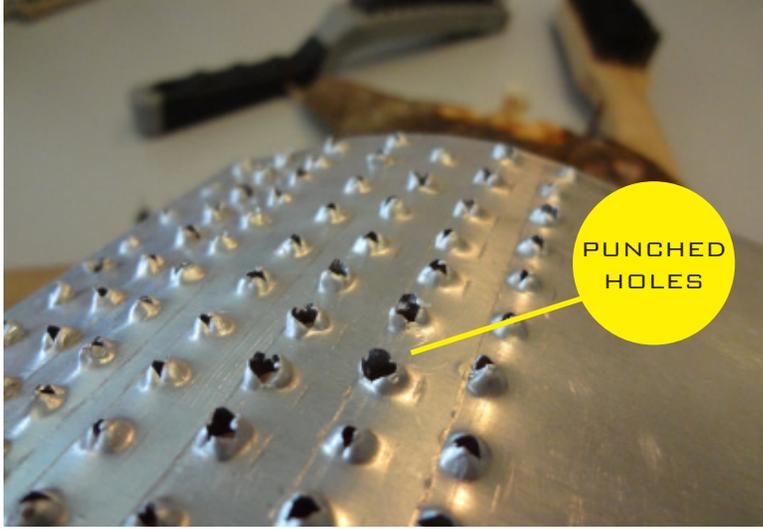
I first used the normal Metal brush which I bought in the store. The result was not good since the metal wires are too hard that cause damage to the flesh. I also tried to use the punched sheet, but it did not take long for me to realize that the inflexible punched sheet can not peel properly the uneven surface of the roots.

Later I procured more samples of peeling wires to test: Stainless Steel Wires and Nylon Wires. Both of two materials of the wire have many different diameter sizes for choosing.

Both materials gave the very good result, the skin's root can be peeled out easily without damaging too much the flesh and also leave the nice finished surface of the root.

However, the cost of the Stainless Steel Brush is much more expensive than the Nylon one, and also heavier. Due to the pressure on cutting down the cost of the machine, I temporarily choose the Nylon material. Although there are some argument about the harmfulness to environment of this material. But I still wish there will be other "greener" solution for this issue.









However, the Nylon brush has shown its problem soon after a test run. There was a lot of dust stuck in the brush. And it seemed that the dust cannot be washed easily with water. So how to clean it? In the effort to clean it, inadvertently I was seeing myself using another brush to comb the dusty one.

And it is interesting since I realized that it is the reason the rollers of the industrial machine are purposely placed near each other. As when the rollers rotate, they will slightly pass each other and automatically be cleaned.

This point has strengthened my idea in using an opposite brush for soft- clean during peeling. And later on I figured out that a sheet of metal not only can do this job more effective but also simpler and lighter.

## BRUSH PRODUCING

Wire Brush has a long history, the origins of the wire brush are unknown, although it is believed that the Romans used similar tools in the manufacture of roof tiles.

Today, Wire Brush is a popular tool and used in many purpose: cleaning, deburring, transporting, sorting, washing, guiding or structuring.

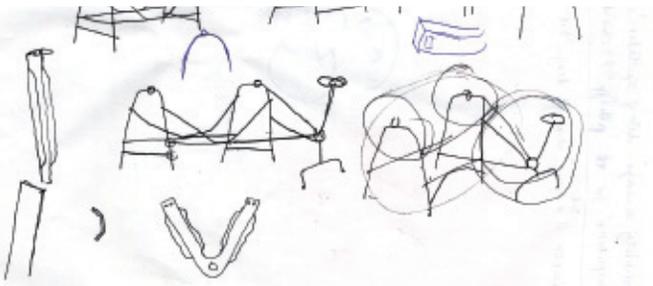
For example, Osborn's global operations currently serve in more than 100 countries with the widest range of tested and proven surface treatment and finishing tools, brushes, polishes and compounds backed by reliable local support. In Brazil, Osborn International has operation Factory in São Paulo, and distributions in more than 10 big cities around Brazil including Manaus.

It means, I believe, producing brush locally would be easily achievable.

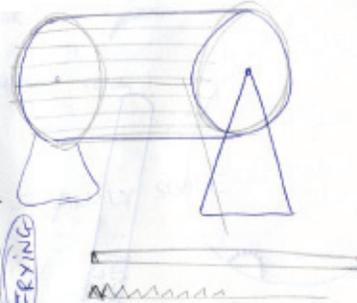


# CONCEPT DEVELOPMENT

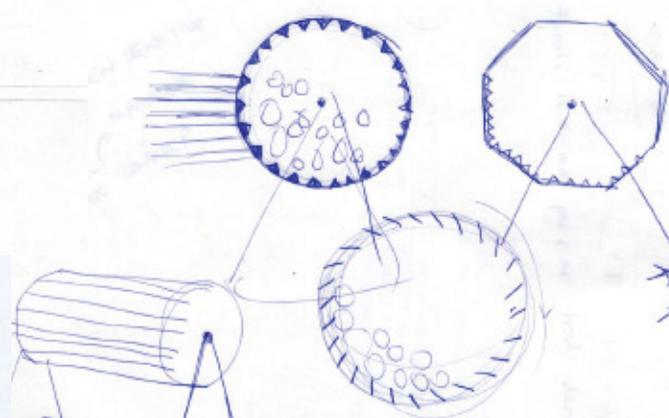
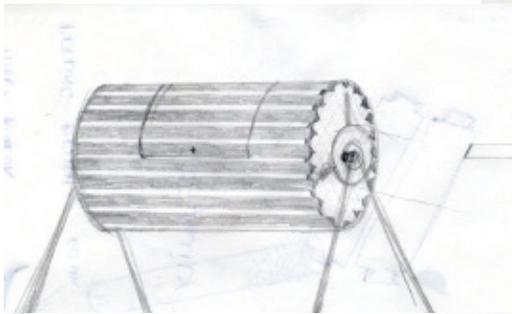
CASSAVA PEELING MACHINE CONSISTS:  
 + (1) conveyors arrange in parallel  
 + Rotating brushes (60cm long)



CASSAVA PROCESSING  
 WASHING  
 PEELING  
 WASHING  
 GRINDING  
 PRESSING  
 DRYING (oven)  
 FRYING

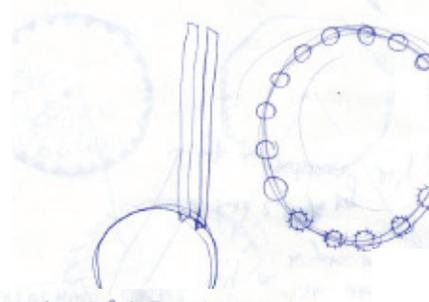
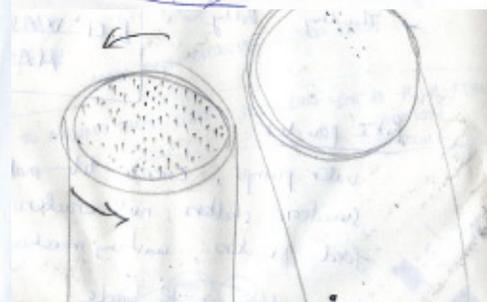
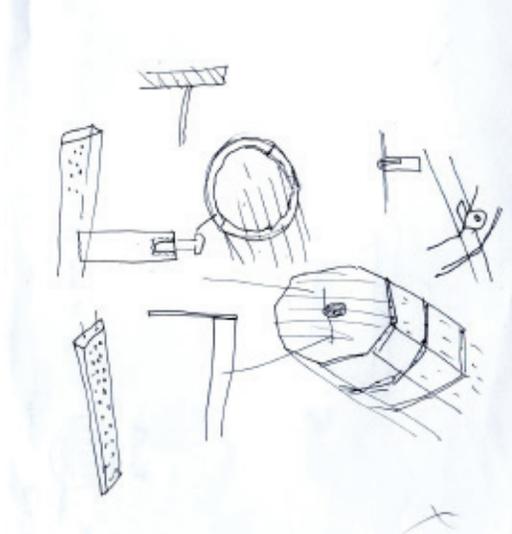


Peeling Process



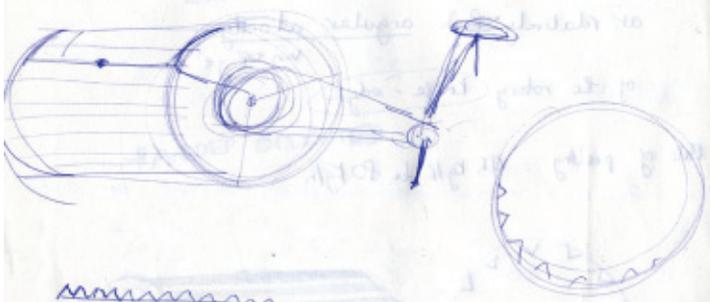
CASSAVA PROCESSING MACHINE INITIAL OPERATIONAL COST CAPACITY SIMPLICITY (LOW EARLY ADOPTION)  
 0.35 kW electric motor → peel

PEELING  
 Peeling all things together  
 → slide  
 → sketch  
 → making



10 - 15 cm  
 15 - 20 cm  
 20 - 25 cm  
 25 - 30 cm

CUTTING OFF TRIMMING  
 ↓ REDUCE  
 ↓ ELIMINATE  
 PRONOUNCED BENDS COMMONLY FOUND IN CASSAVA TUBERS



DRIVING CASSAVAS ON ROLLERS TO MORE BASIC CONCEPT LIKE ABRASIVE ROLLERS WITH TEETH RUBBING THE SKIN OFF

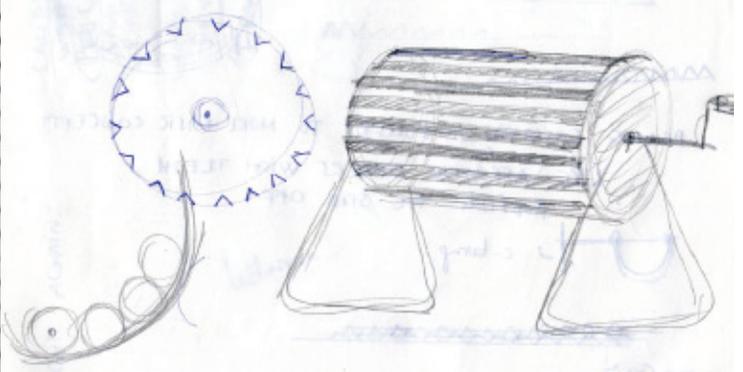
c-lamp  
 prong (metal)

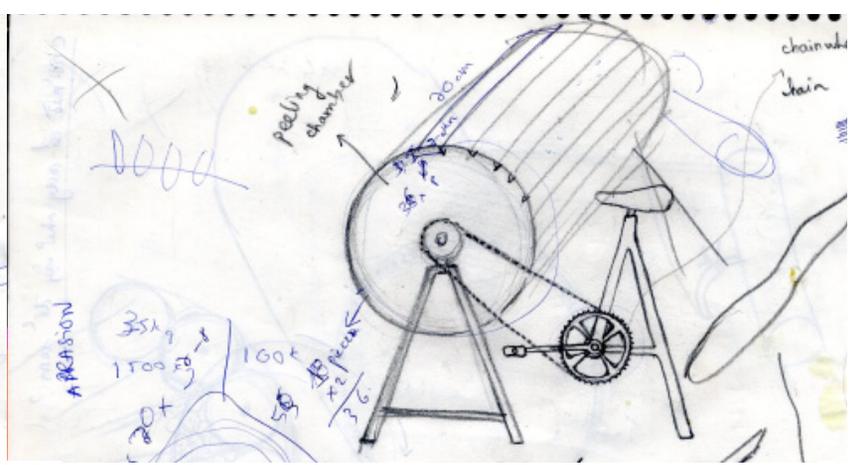
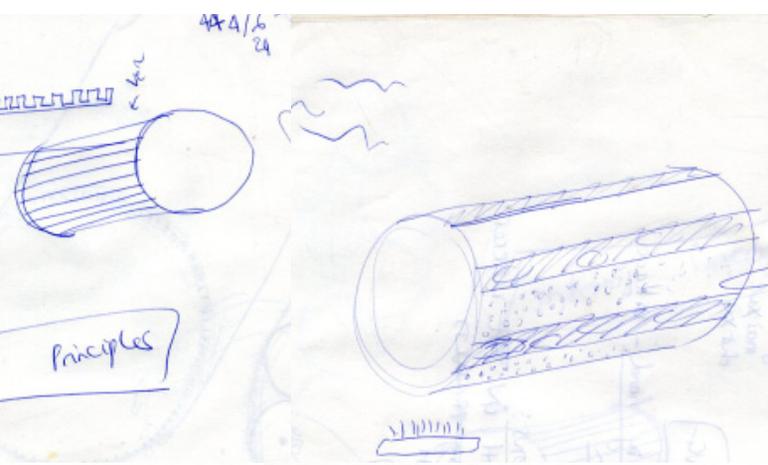
A CASSAVA-PEELING MACHINE consists of a 0.35 kW electric motor

- Motor (0.35 kW, electric)
- a Rotary drum fitted with Knives (5cm long)
- protective hood.

OPERATES on the PRINCIPLE of shear force ( $\mu \cdot r \cdot \omega^2$ ) or relatively high angular velocity of the rotary knife-edge

Rate of peeling: 45 kg/h to 80 kg/h





INITIAL COST  
LOW COST  
LOW TECH  
EASILY ADAPTABILITY  
electric motor → 1000 →  
peel 15 kg/h → 30k

Why they don't make it  
why they have to make brushes

Comb  
PRINCIPLE

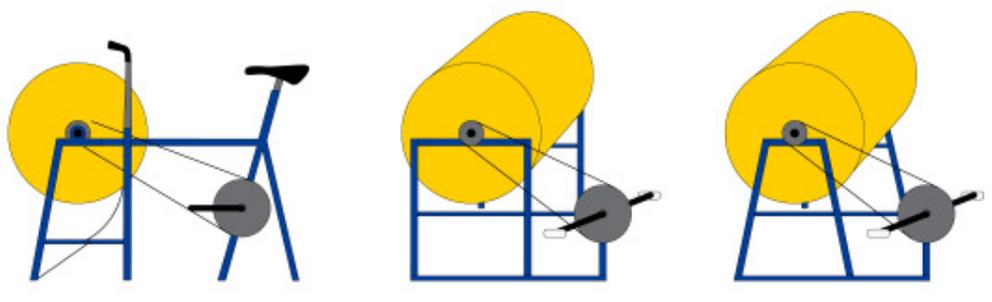
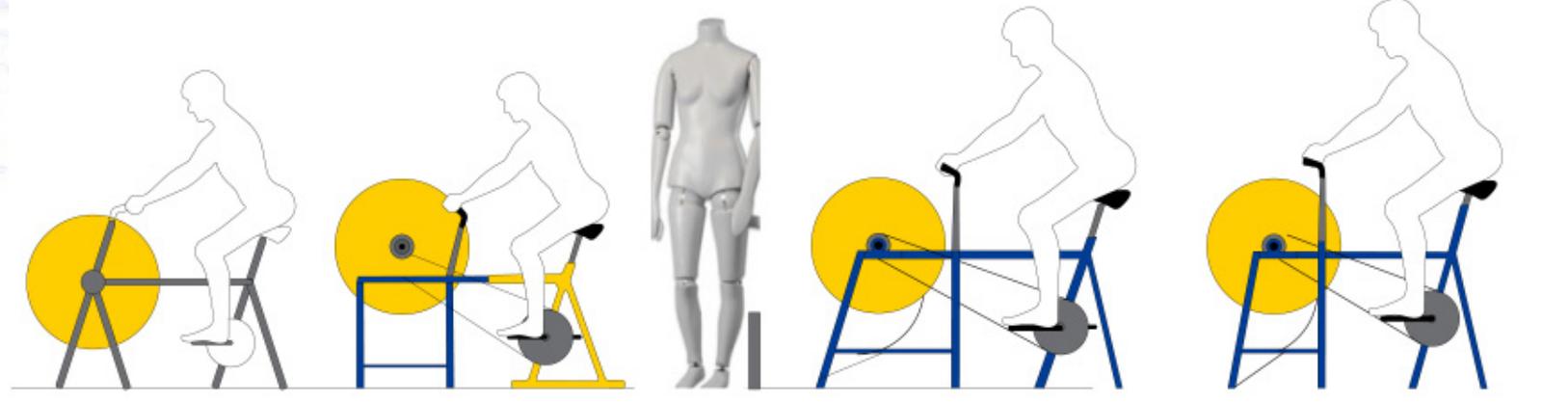
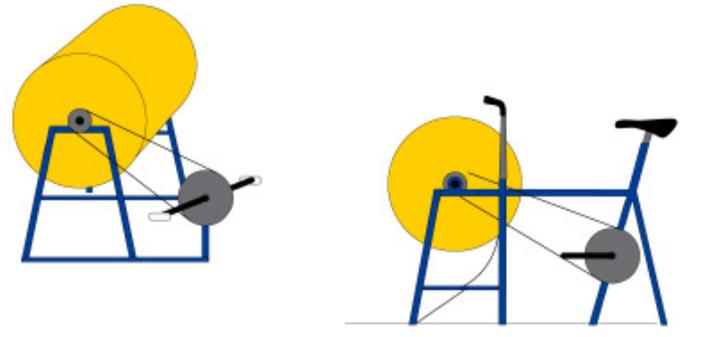
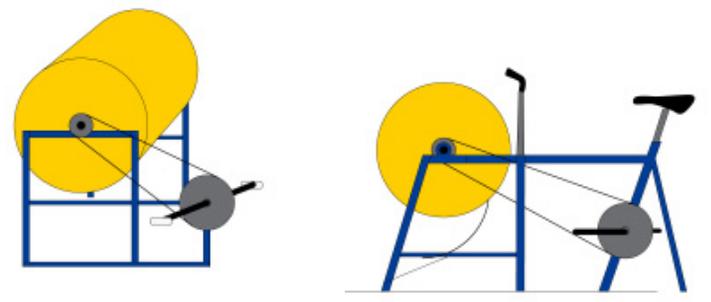
brush friction principle  
maixar  
ch'xat'

**PEELING**

+ Peeling by hand - village  
+ Machine

=  
EXISTING SOLUTIONS  
+ HIGH TECH IN THE MARKET  
- EXISTING PRODUCTS  
+ LOWTECH

WAY OUT



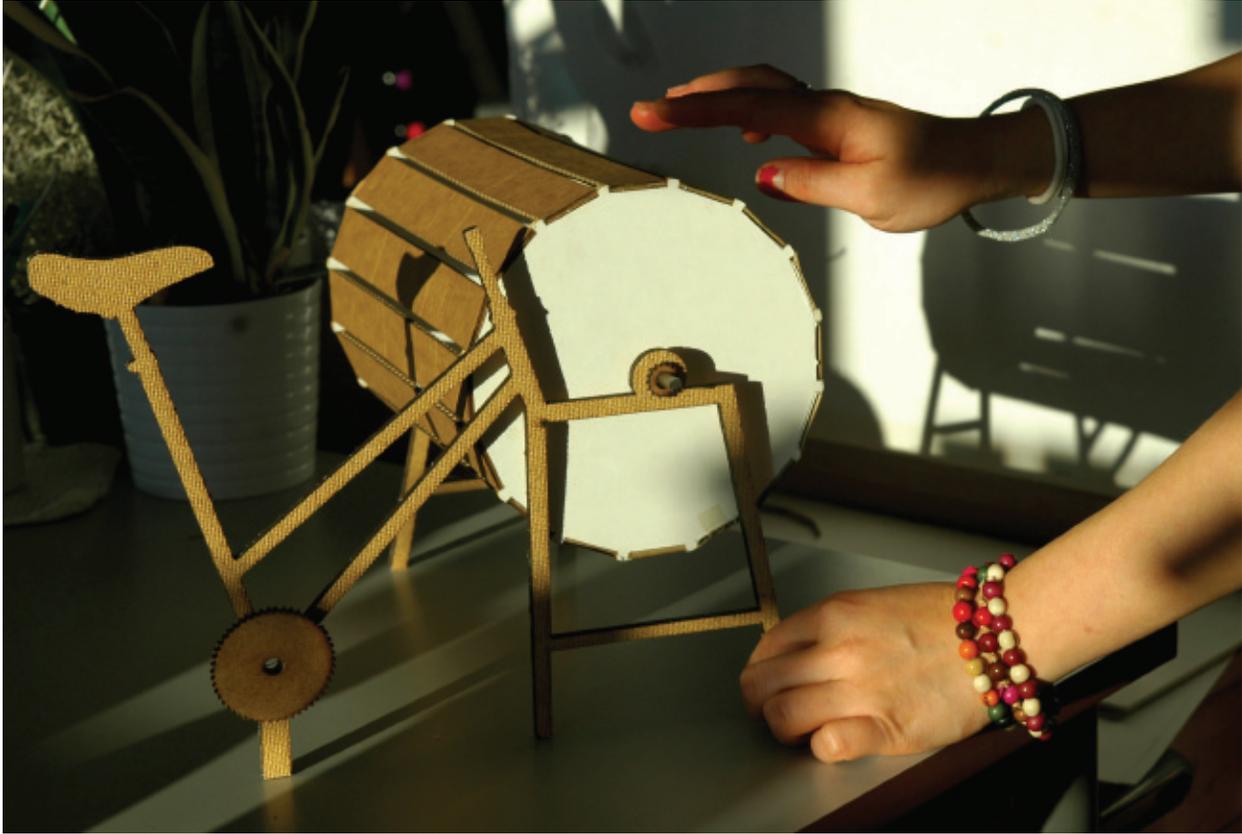
The concept generation began with a benchmarking analysis of products available on the market that could be applied to processing cassava. Machines currently existed were compared to generate ideas on how to effectively peel and grate the roots. Taking into consideration the current conditions of the village that there is no electricity, I decided that the best solution for the machine would involve man power to reduce the operation cost.

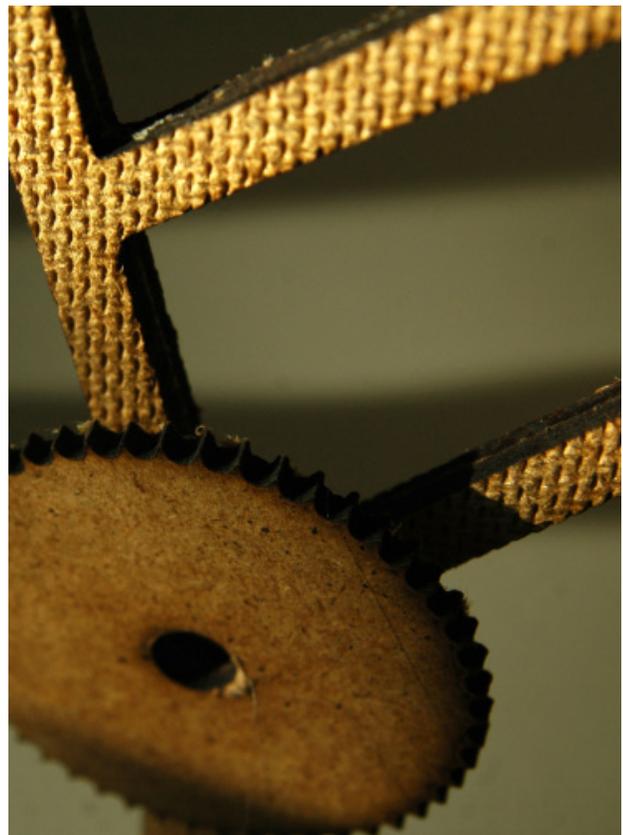
The initial concept of the Cassava Peeling Machine consist of two main parts: Peeling Drum and Pedal Powered. The two most effective types of product evaluated for benchmarking are the wirebrush peeling machine and a typical bike.

The Peeling Drum maintain the purpose of peeling the cassava skin, rollers to more basic concepts like abrasive rollers with wire brushes rubbing the skin off. The pedal part provides power to rotate the Drum.



# SCALE MOCK-UP

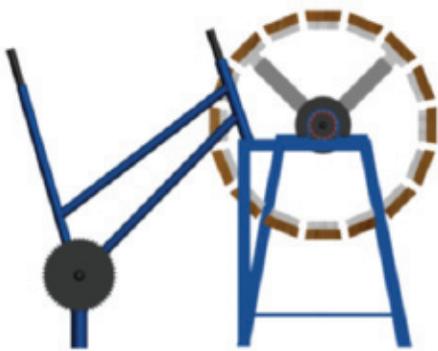
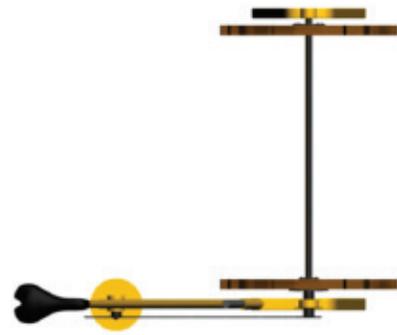




# PROPORTION DEVELOPMENT



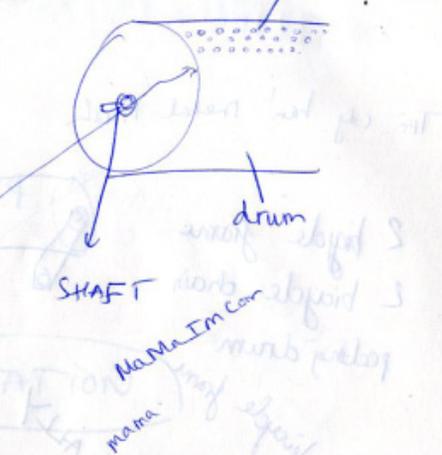
# 3D DEVELOPMENT





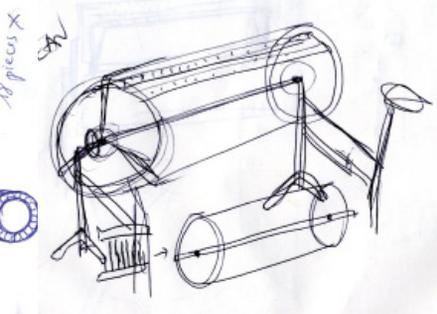
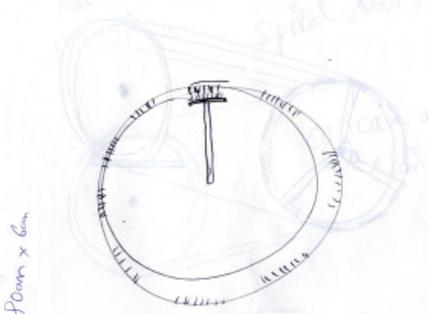


punched with chisel

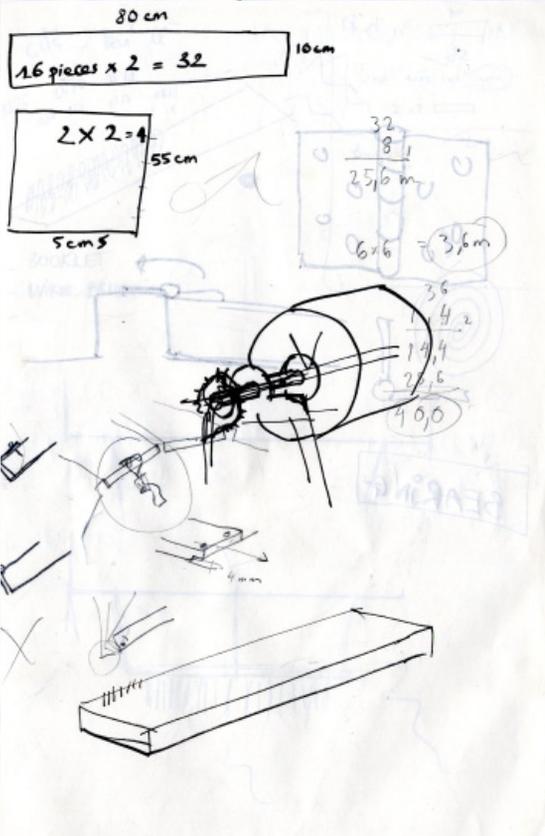


FROM THE ELECTRIC MOTOR COMPONENTS OF THE MACHINES.

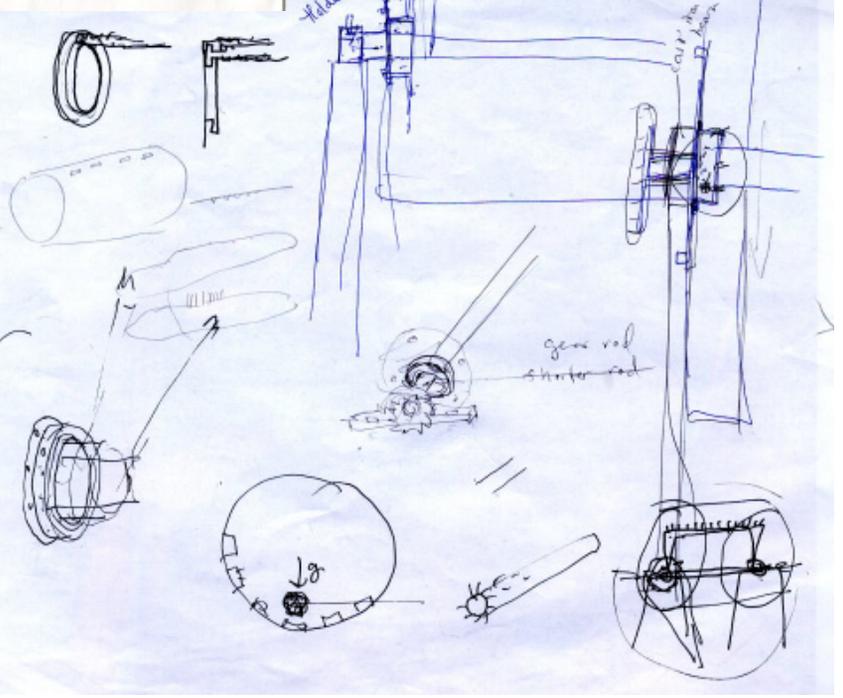
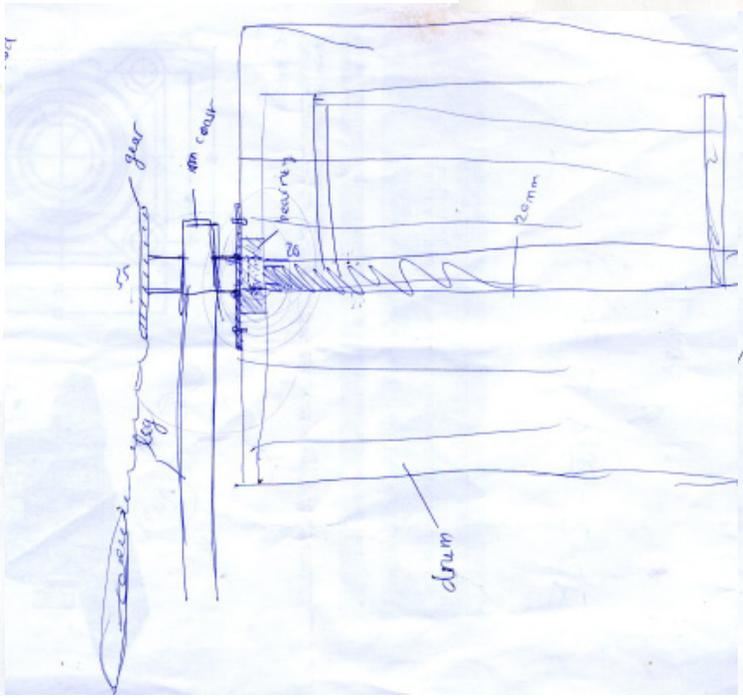
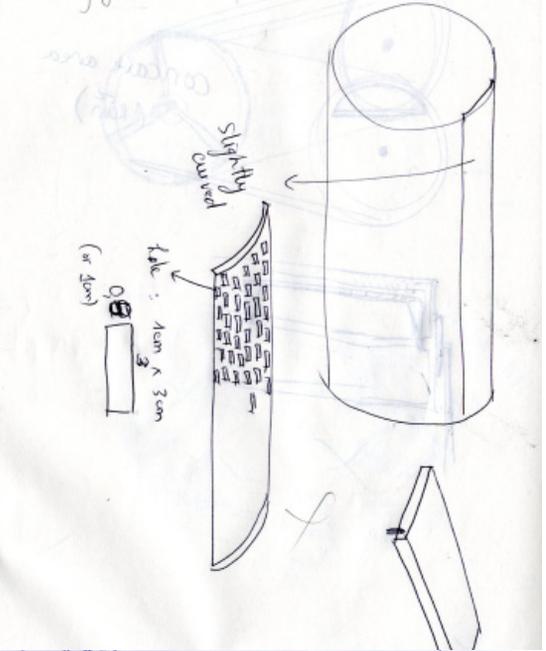
normally expected losses (wanted losses)



16 pieces x 80mm x 6mm

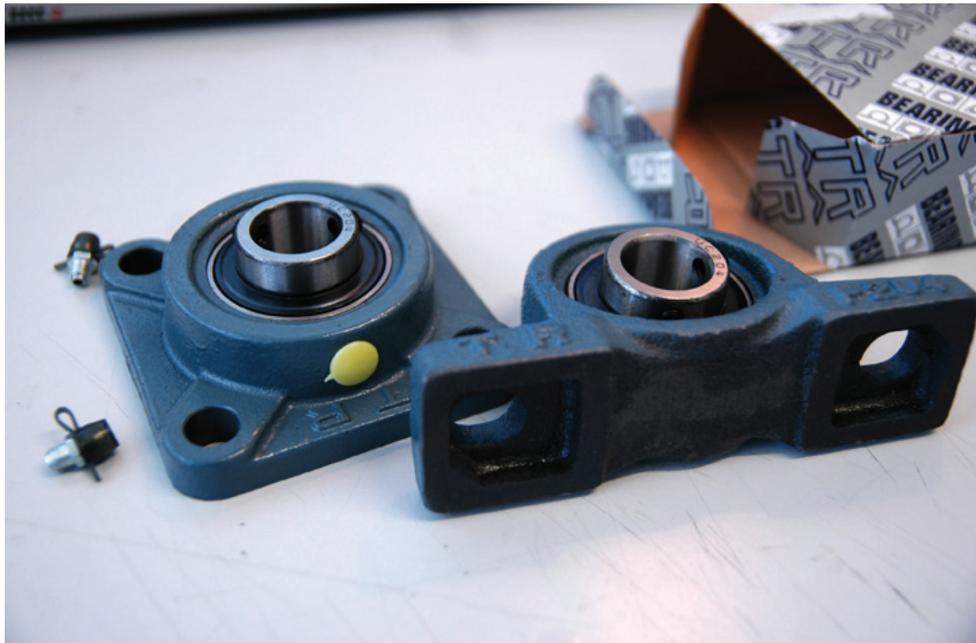


I didn't name the project as Pedal Cassava Peeler just because I'm beginning the project and I'm not to design a cassava peeler or things like that for Amazon R



## BEARINGS

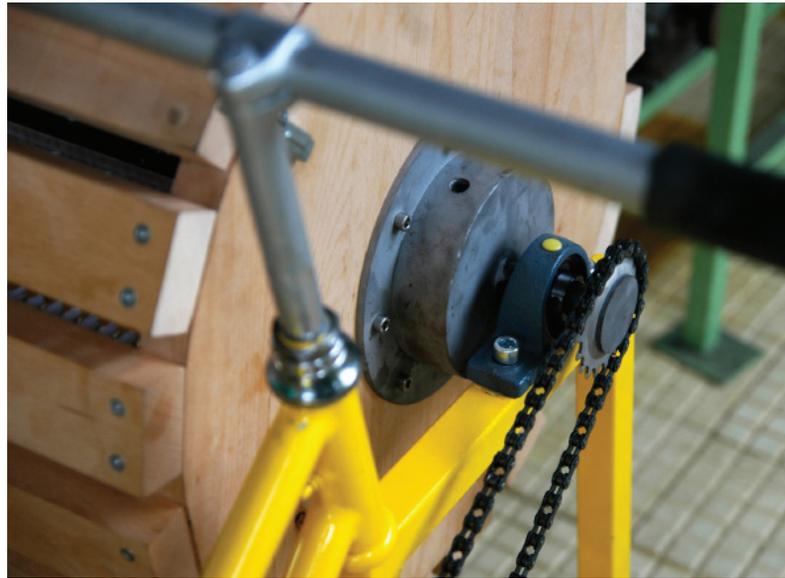
Typically allowing and promoting the Drum to rotate freely around the Axel, I use two Bearings and one Cast Iron Housing. In the first prototype, the bearings in two ends of the drum were located inside the drum. However, later I realized that they are better to put outside for food hygiene reason. The housings for protecting the bearings are then made.

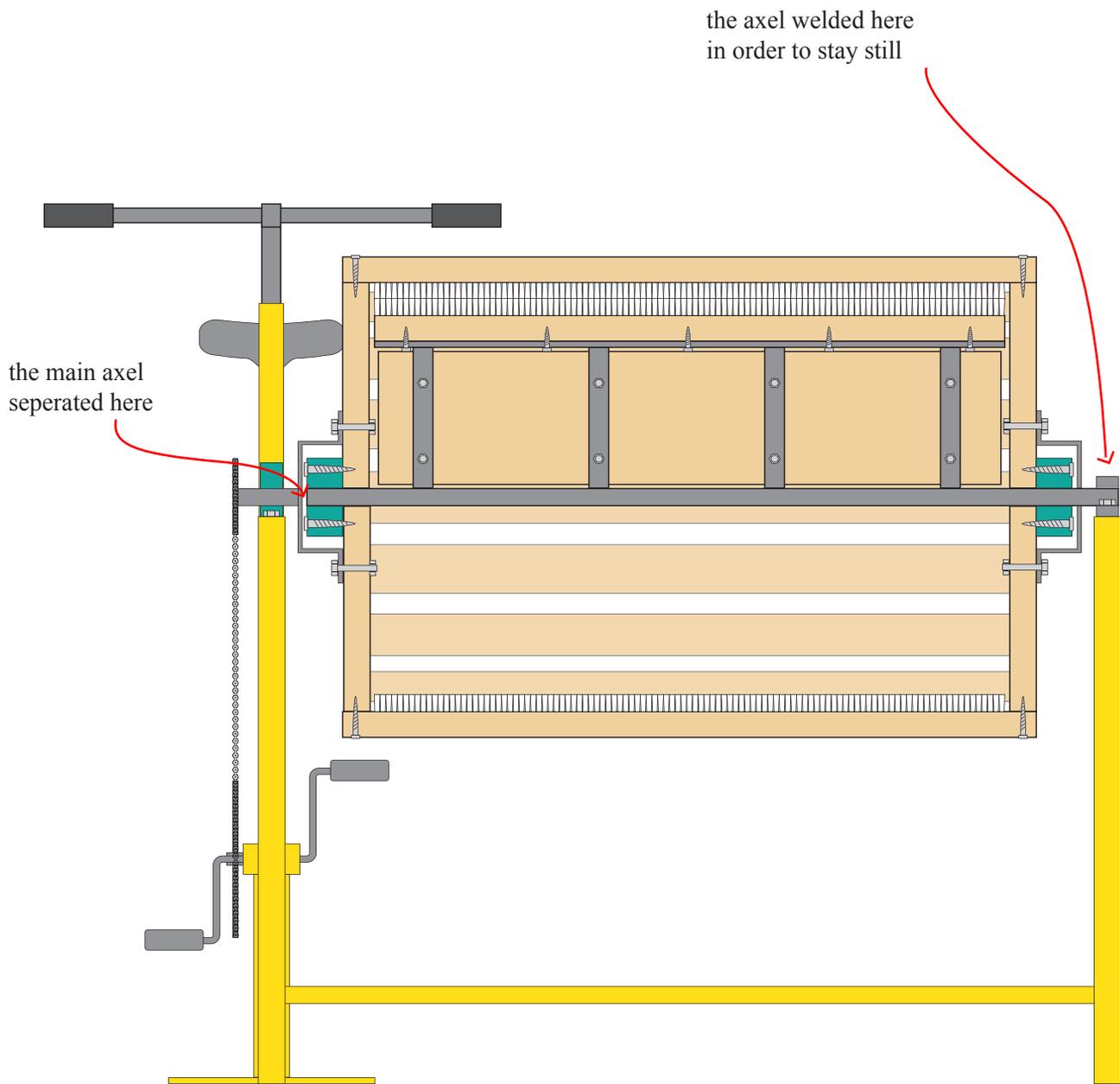


VERSION 1



VERSION 2



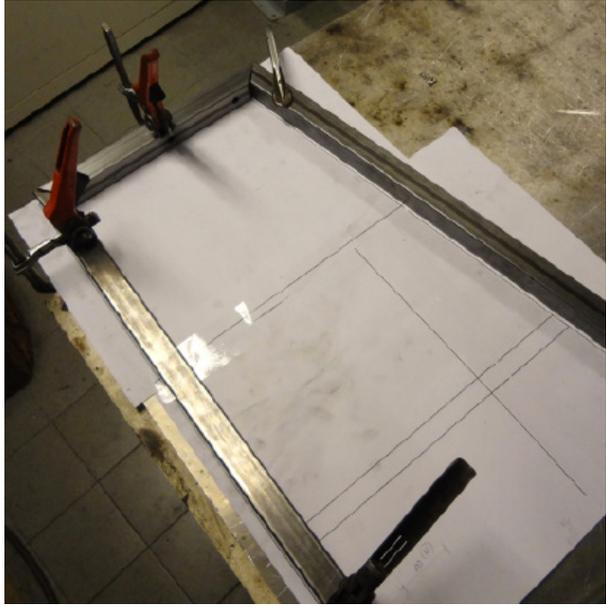


## THE MAIN AXLE & CLEANING ISSUE

One of the most challenges in designing this machine is the Cleaning issue. As I describe above about the problem of the dust and the solution to clean the Brush Bars of the Drum, there is one other brush- bar inside the drum, fixed to the axel and maintains a purpose of combing the dust from the drum- brushes.

It means that, when the Drum rotates to peel out the root's skin, the Clean Bar have to stay still and clean the Drum- brushes. In order to allow the Clean Bar stays still, the Main Axle of the machine has to be separated in to parts: one will hold the Drum with Clean Bar (inside the Drum); one will connect with the Bike's wheel.

The cleaning bar needs to adjust to the right position so that it can comb the drum- brushes appropriately without blocking the drum rotating. Also, the cleaning bar needs to have a frame to prevent the roots stuck when they are rotated...And when it comes to real running, I realized that the bike and the frame to hang the drum need to be more consolidated.





## RESULT

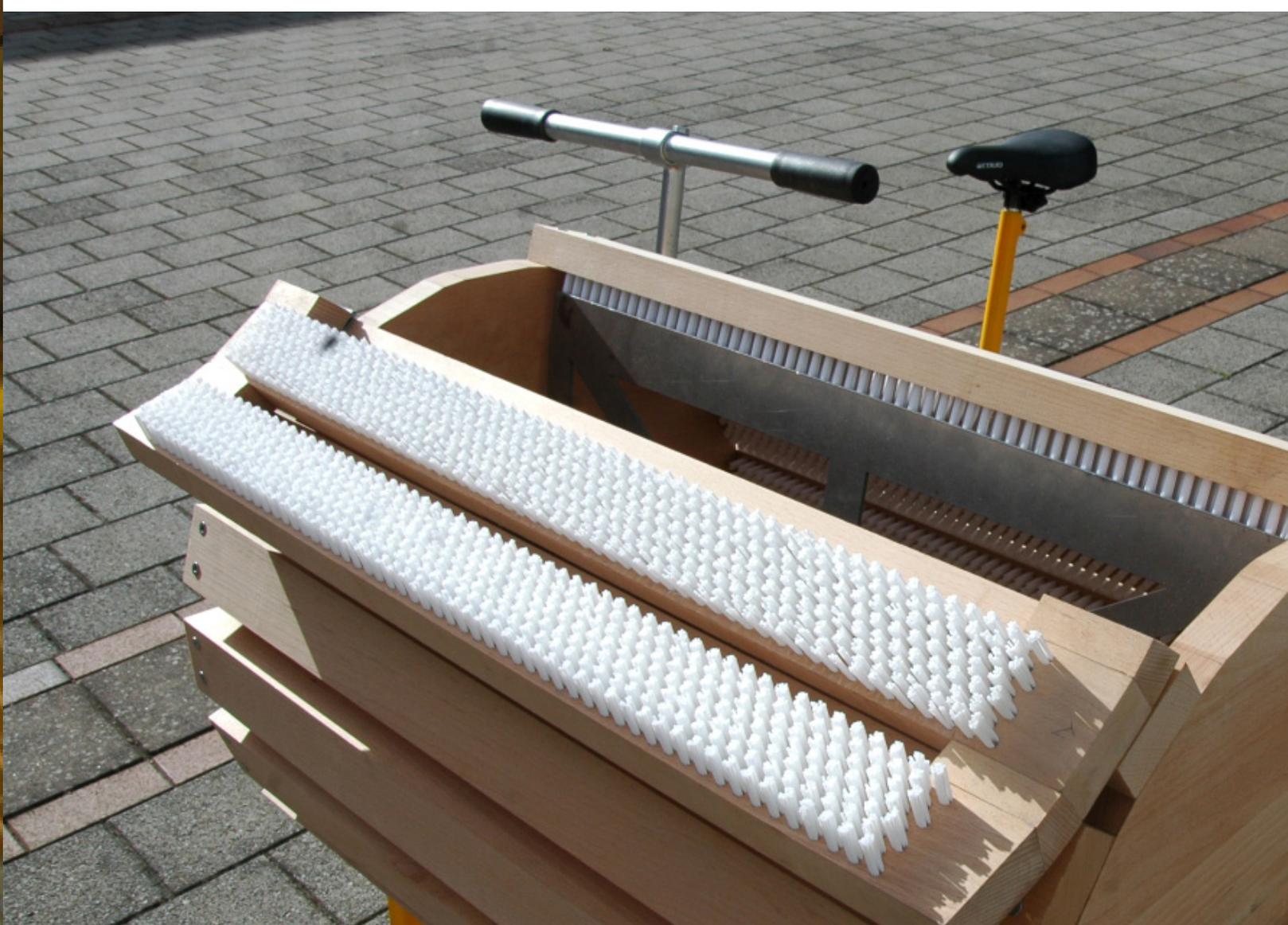


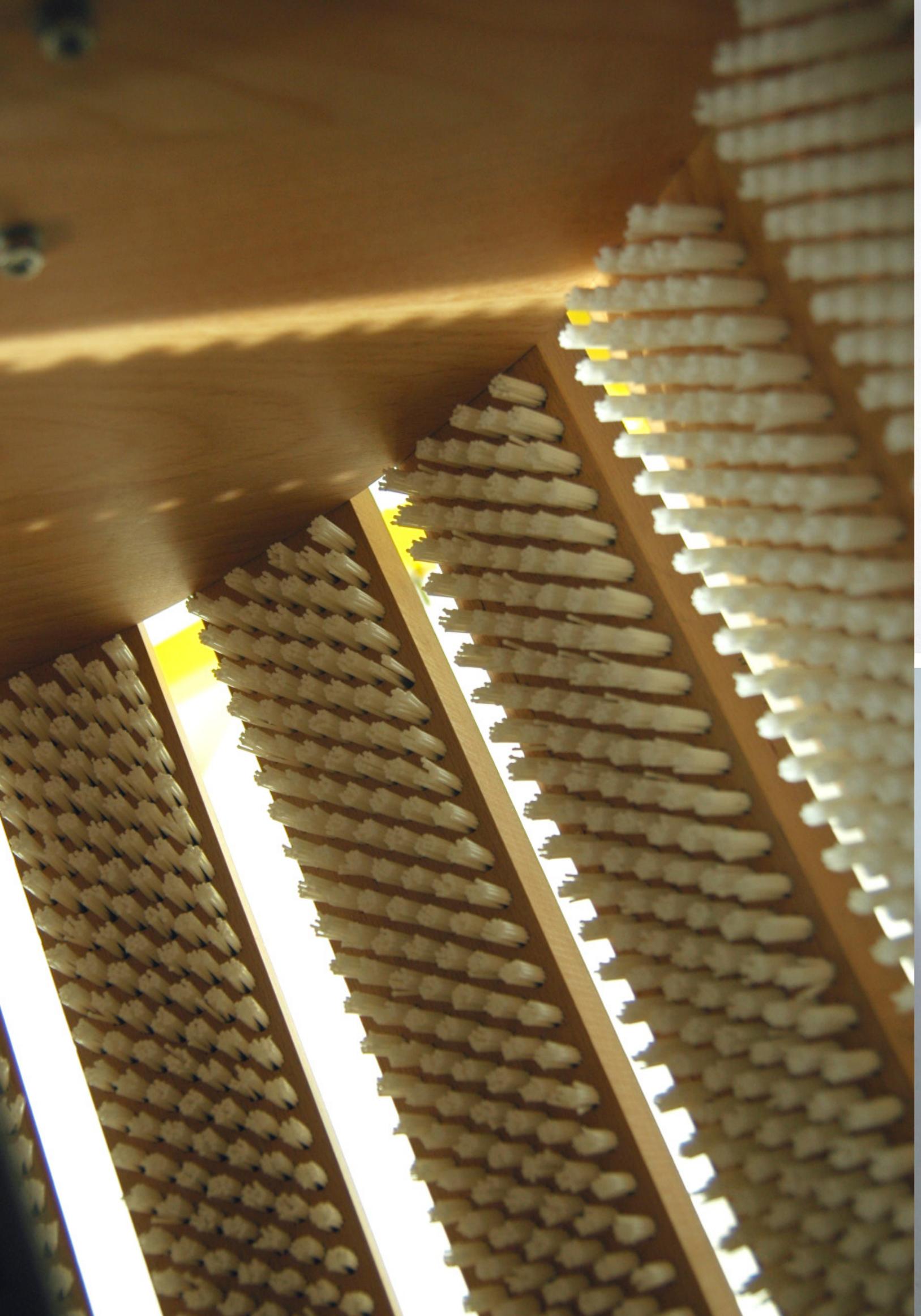
THE RESULT IS A CASSAVA PEELING MACHINE IS TO BE DESIGNED TO IMPROVE WORKING CONDITION, INCREASE THE PRODUCTIVITY, REDUCE PRODUCT LOSSES, TIME CONSUMPTION AND PHYSICAL LABOUR POWER. INTEGRATING THE MECHANISM CONCEPT AND THE MOST HI-TECH PRINCIPLE IN PEELING ROOTS IN ORDER TO PROVIDE A SIMPLER, BETTER SOLUTION THAT IS MORE ACCESSIBLE, AFFORDABLE, WITH CLEANER TECHNOLOGIES. DUE TO THE LIMIT OF ELECTRICITY AND HIGH COST OF GAS, PEDAL POWERED IS CHOSEN. THE ROTATED DRUM EFFICIENTLY MAINTAINS THE PURPOSE OF RUBBING THE CASSAVA SKIN OFF, TECHNICALLY ADAPTS TO HIGH-TECH ABRASIVE ROLLERS WITH WIRE BRUSHES.













## USING INSTRUCTION

### STEP 1: WASH & SOAK

Cassava after harvested should be washed and soaked in water for about 5- 10 hours before loaded in to the Drum. It is also recommended that the roots should be peel immediately after harvested.

### STEP 2: LOAD

Cassava after washed and soaked in water, should be loaded into the Drum. The capacity of the Drum is up to 20kg. However, it is recommended that the Drum should not be full. So that the roots will have enough space to rotate around.

### STEP 3: BIKE

Cassava after loaded into the Drum, the door should be closed and locked. Start biking to rotate the Drum for about 10- 15minutes. Stopping in the between to check the roots are allow. It is also recommended that the biking speed should be maintained at medium level (not too fast), so that the roots will not fly over and have enough time to touch in the brushes.

### STEP 4: UNLOAD

After 10- 15 minutes, check if the roots are peeled properly, turn door of the Drum upside down, open the doors and remove all the roots out of the machine

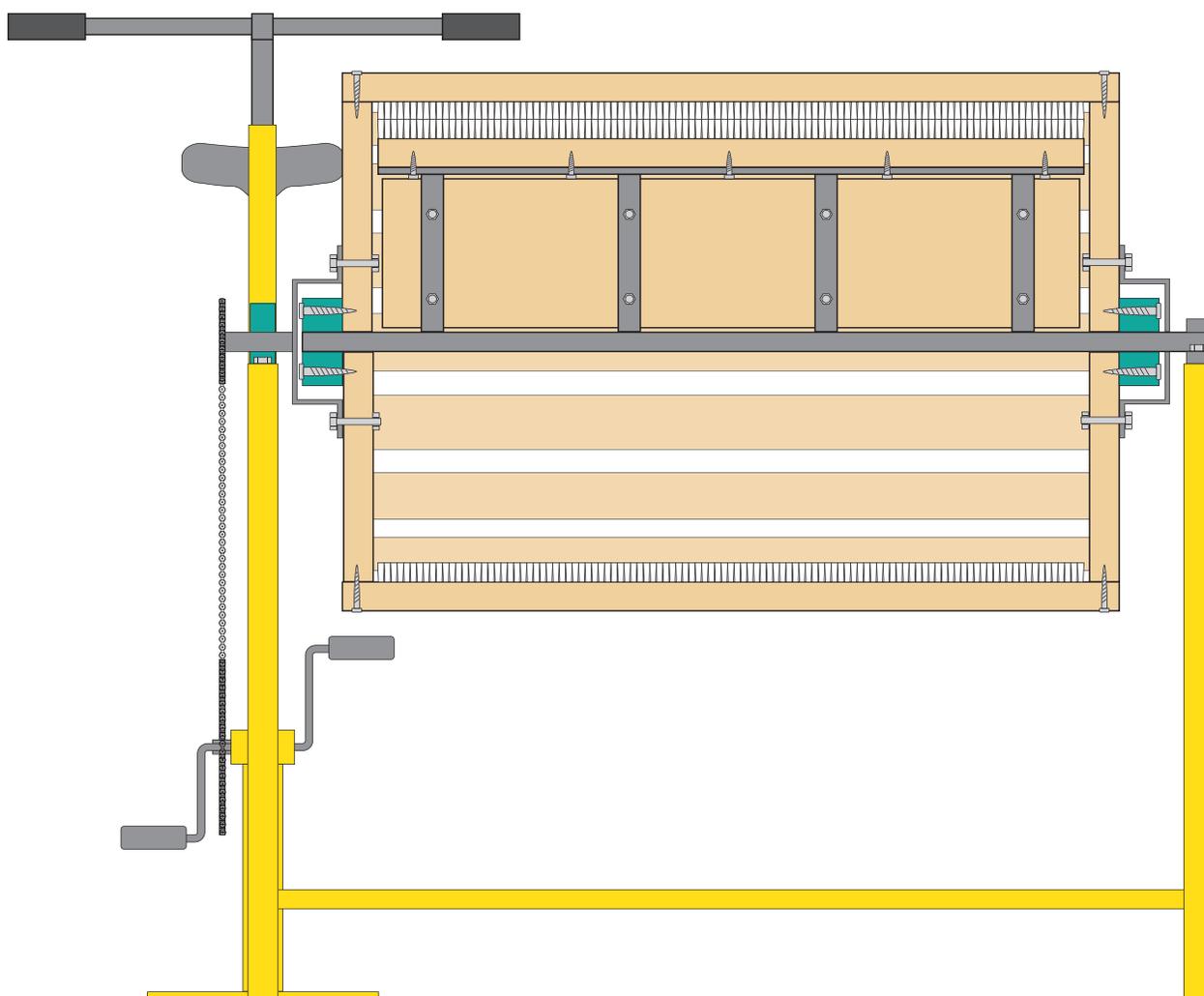
## PRODUCING & MAINTAINING

The machine is to be designed to encourage local producing and using recycling materials. The machine basically has 3 parts: the Drum, the Frame and the Pedal Power:

- Pedal Power: totally can use an old bike for this part.
- Frame: simply can be done at local metal fabricators with local affordable price.
- Drum: mainly made from Wire Brush Bars, since Wire Brush Producing is really popular around the world and in every countries, it is recommended to check with local place about the possibility to produce locally. One Drum has 20 Wire Brush Bars totally which can be changed piece by piece in case of broken or old.

Also, my ambitious is to get the involvement of the local organisations for mass producing in order to be able to distribute the machine to farmers at a very low- cost or for charity. The whole machine using simple materials and easy structure also totally can allow the farmers build and maintain themselves.

# PRODUCT MANUAL



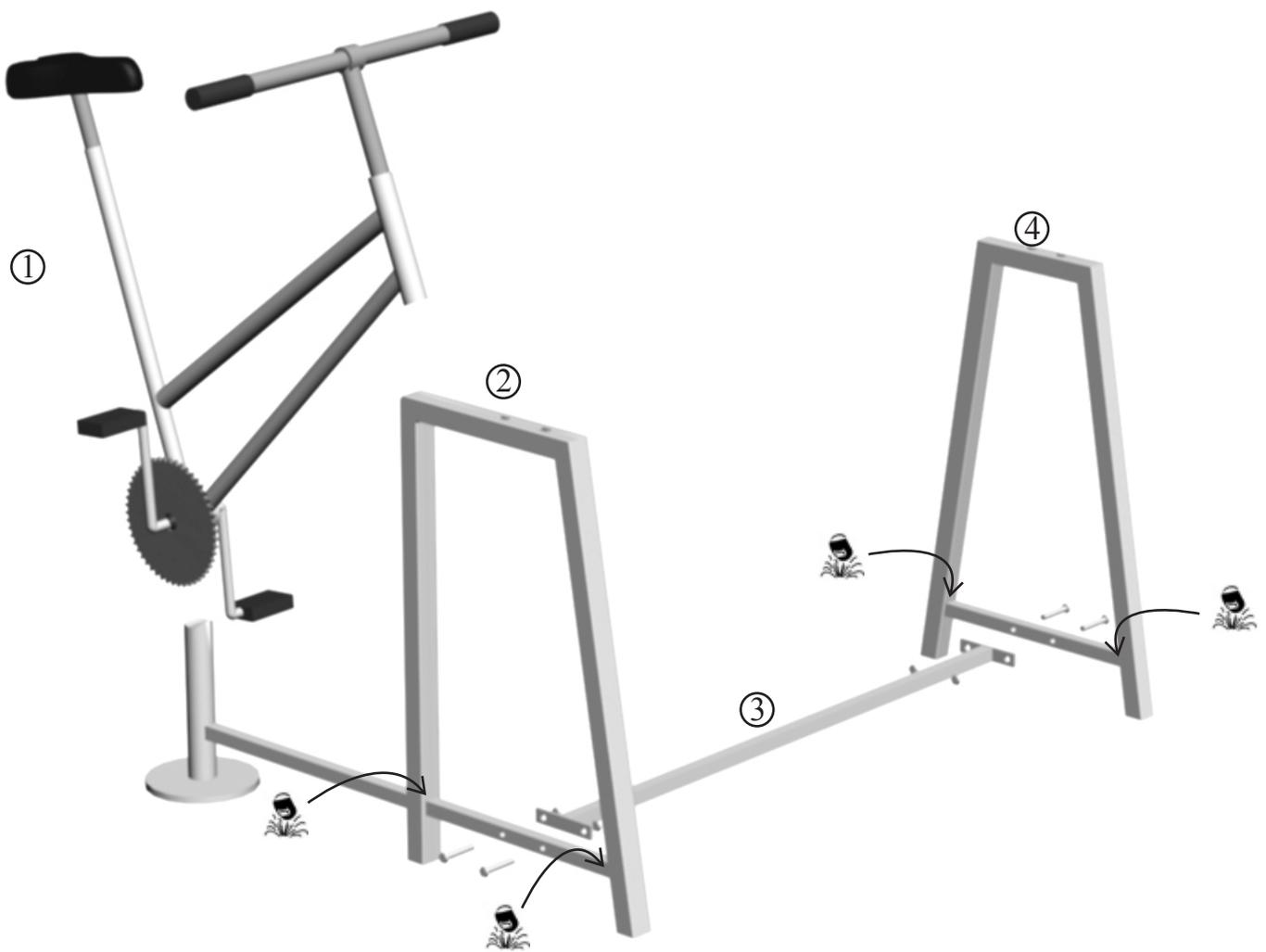
A



B

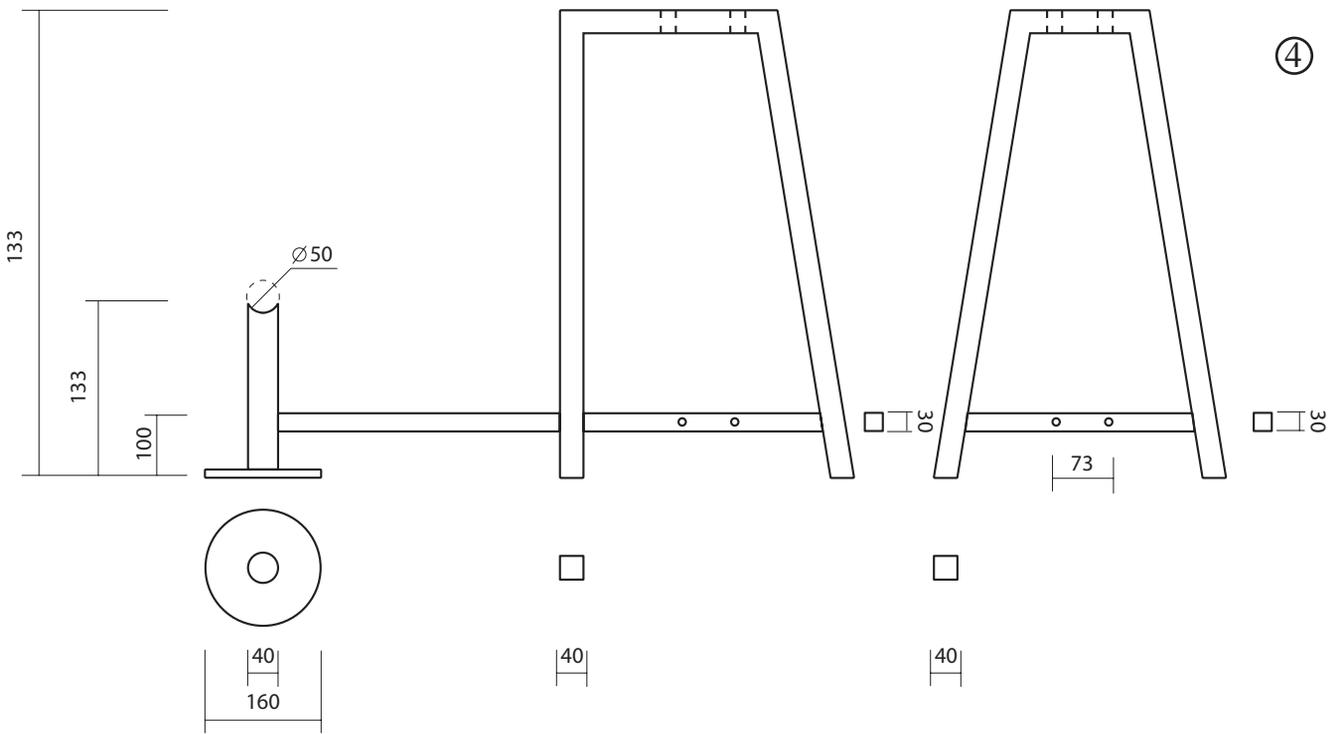
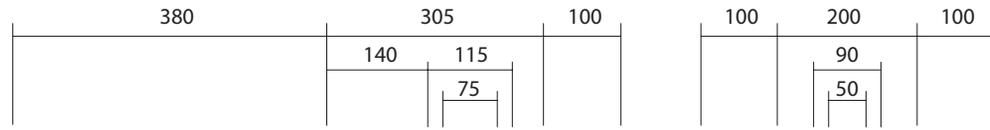


A

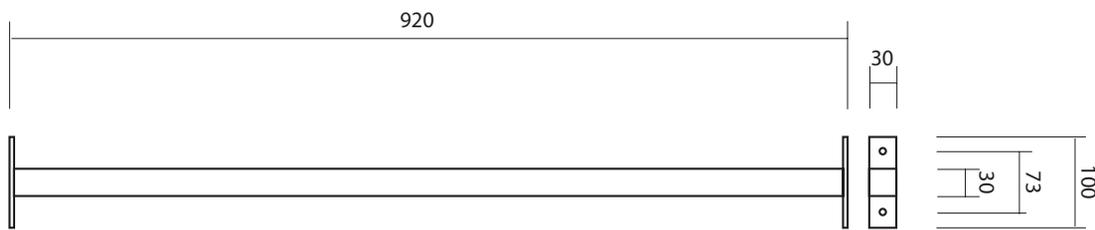


① Bicycle Frame re-used from old bike

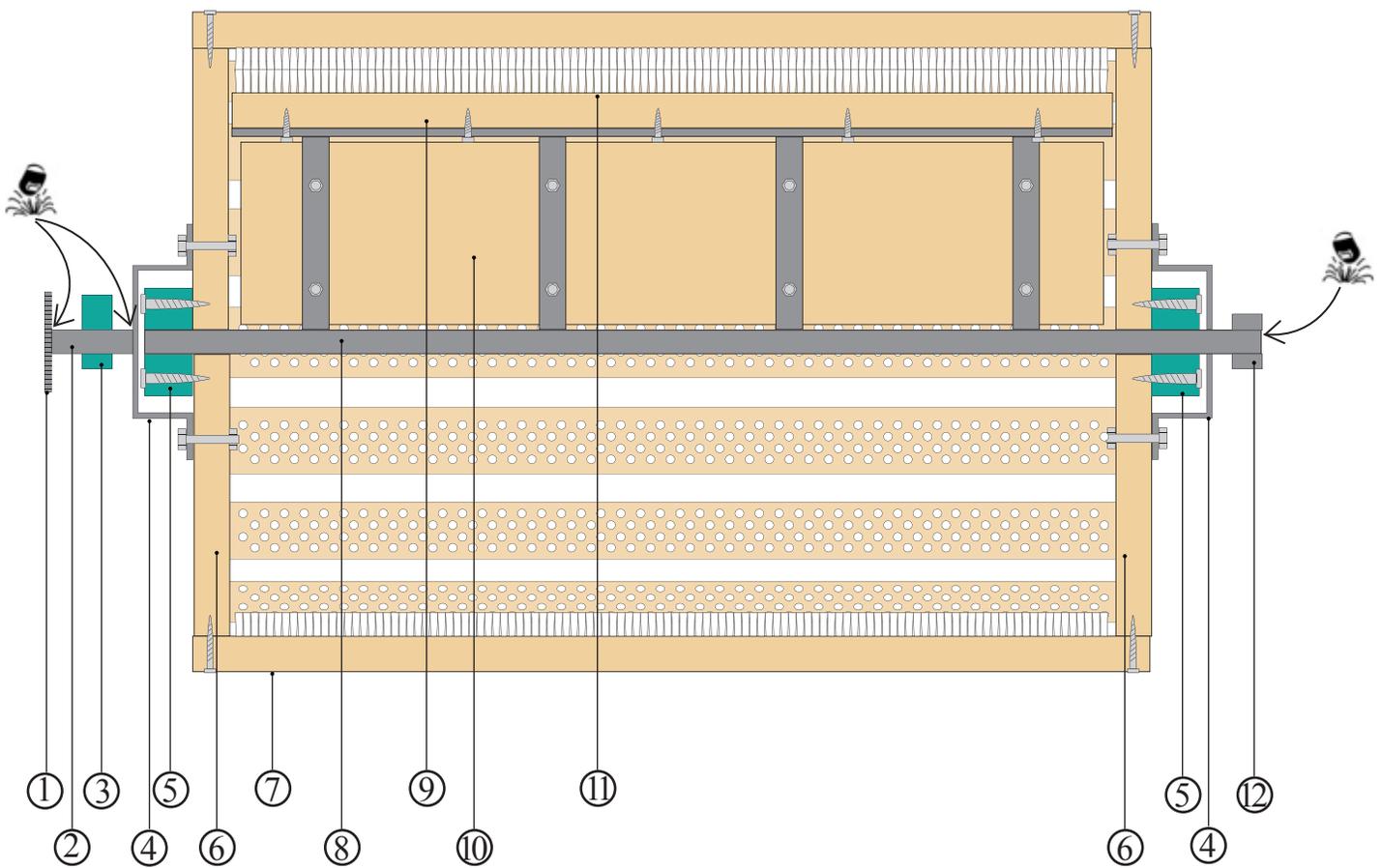
②



③



# B

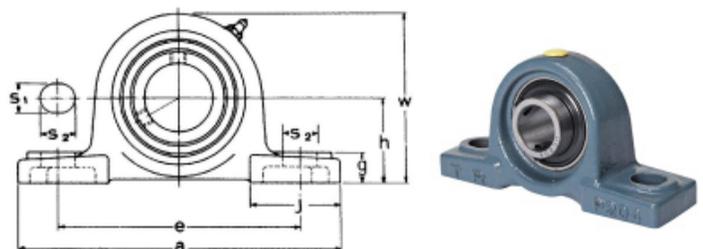
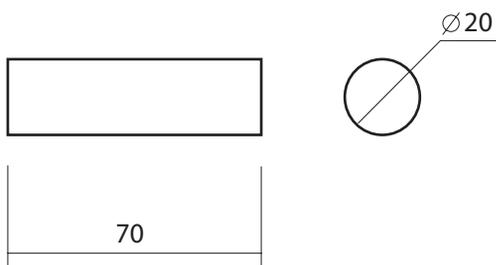


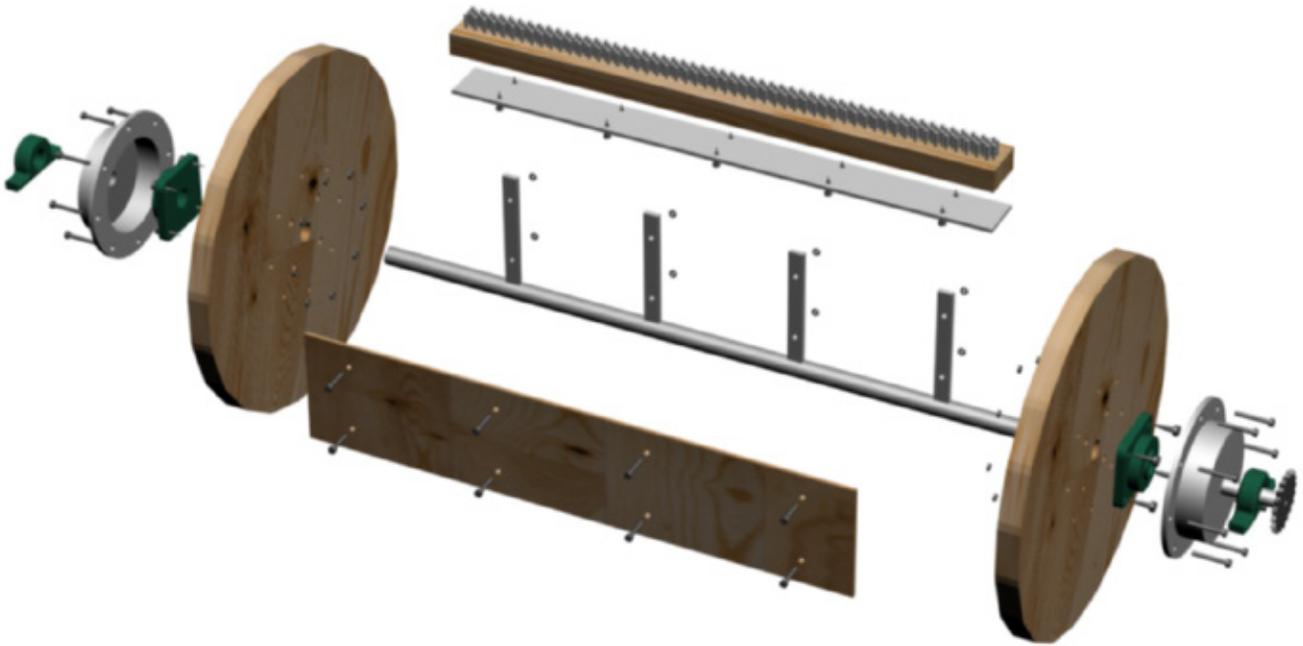
① Bicycle single speed freewheel

③ Pillow Block Bearing

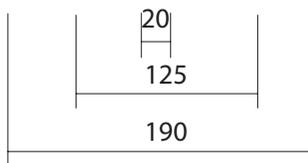
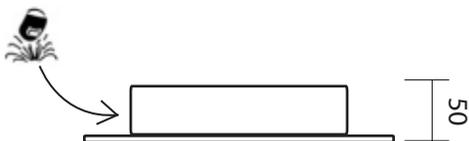
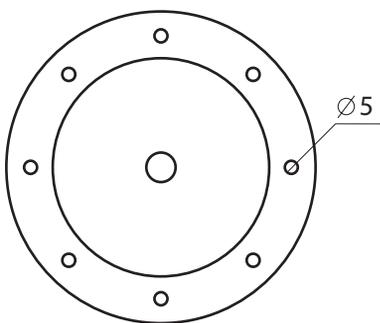
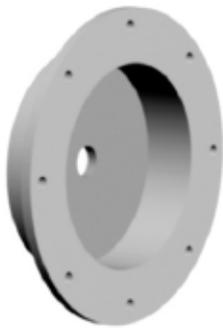
H: 33,3 mm. A: 127 mm. E: 95 mm. S2: 16 mm.  
S1: 13 mm. G: 14 mm. W: 65 mm. Hole: Ø 20 mm. Depth: 38 mm.

② Solid steel rod



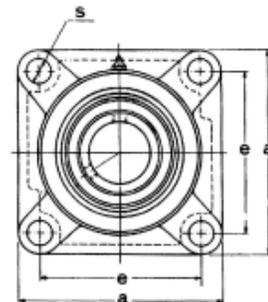


④ Bearing Housing: 2 pieces



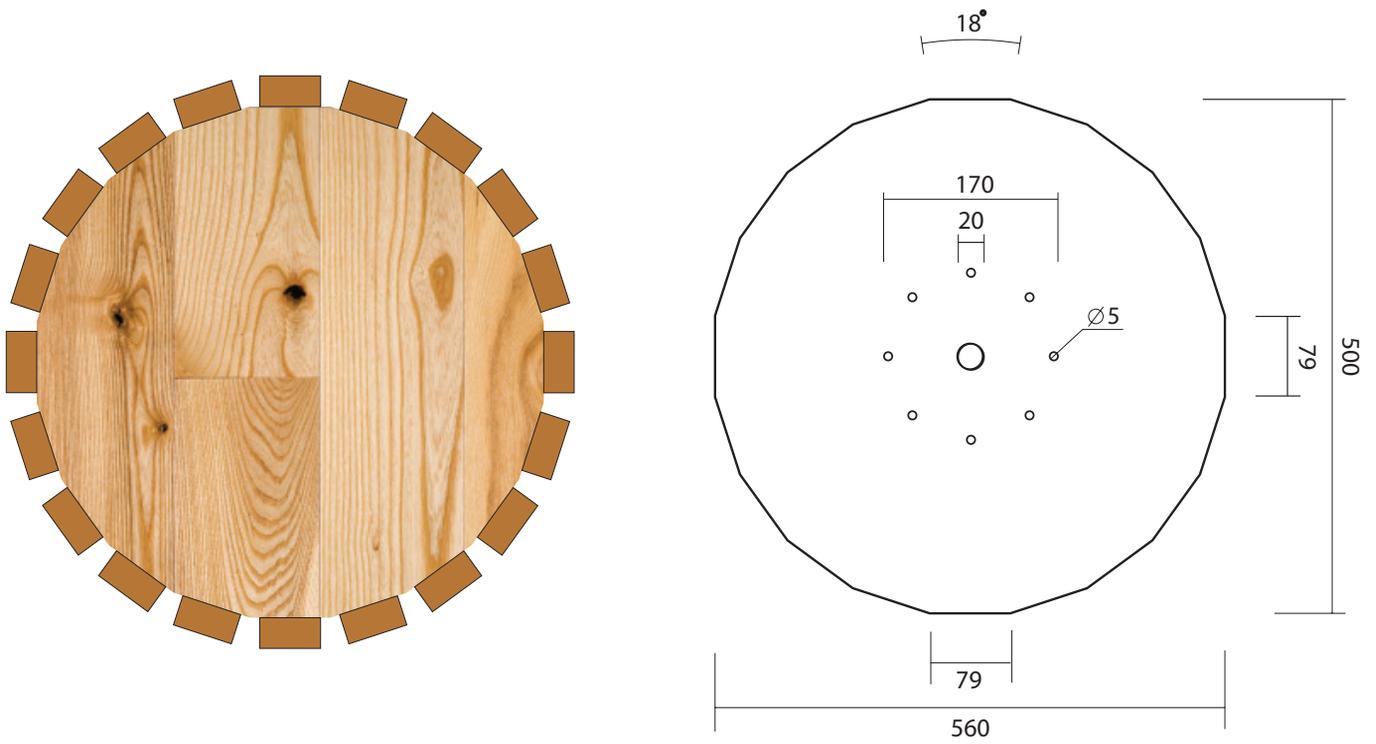
⑤ Bearing: 2 pieces

A: 108 mm. E: 83 mm. S: 12 mm.  
Hole:  $\varnothing$  30 mm. Depth: 40,2 mm.

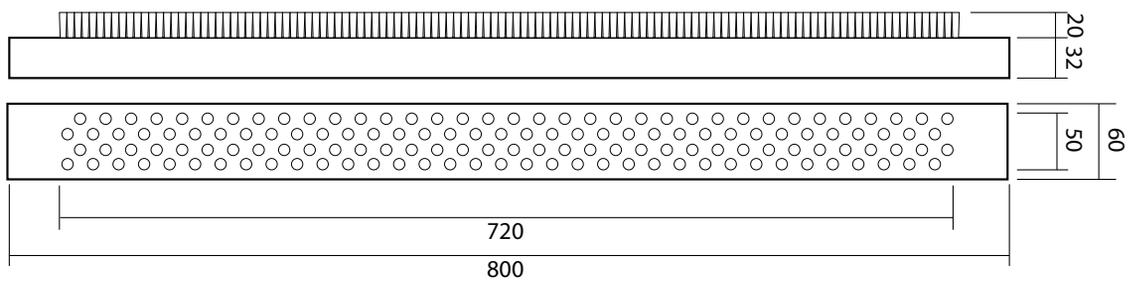


**B**

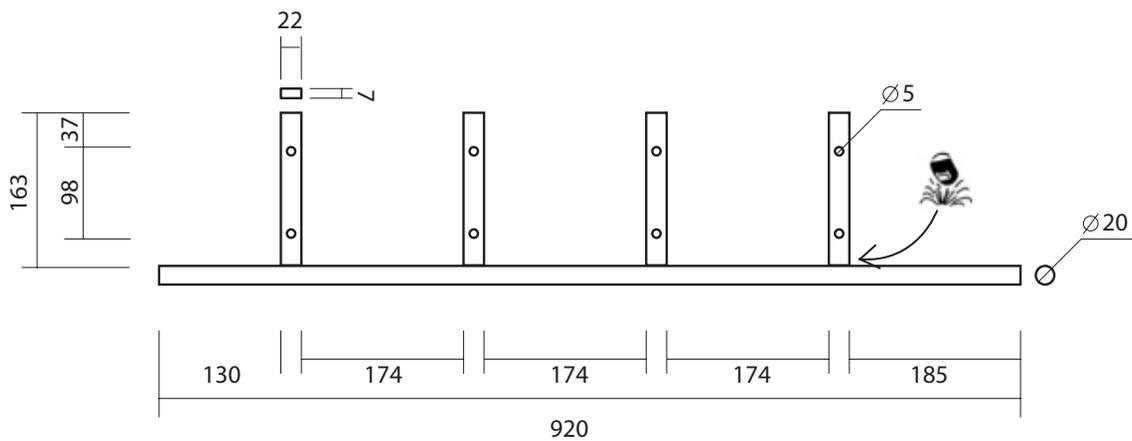
⑥ Drum Cap  
Quantity: 2



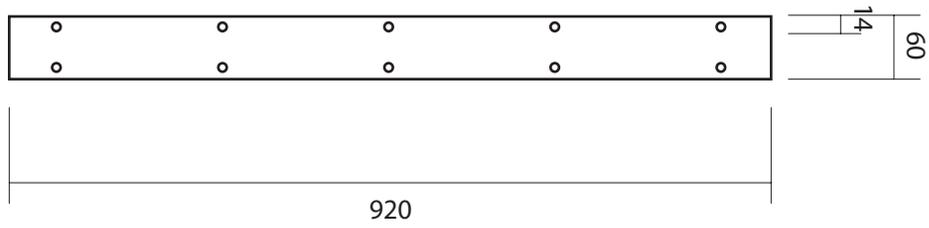
⑦ Brush: 20 Pieces; Wood Body; Nylon Wire



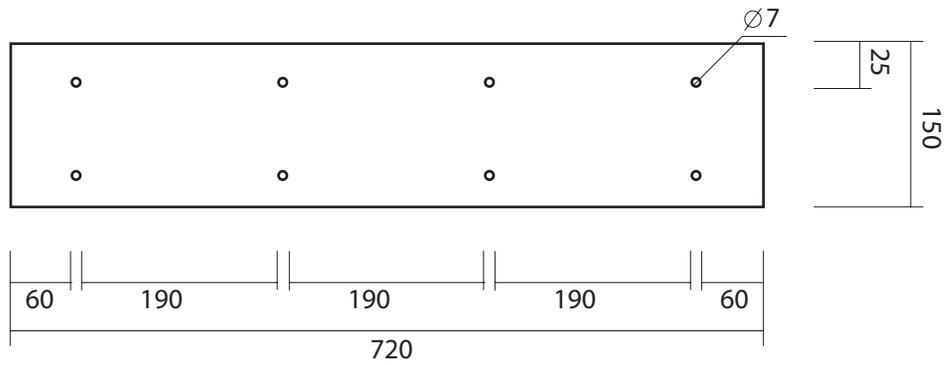
⑧ Solid Stainless Steel



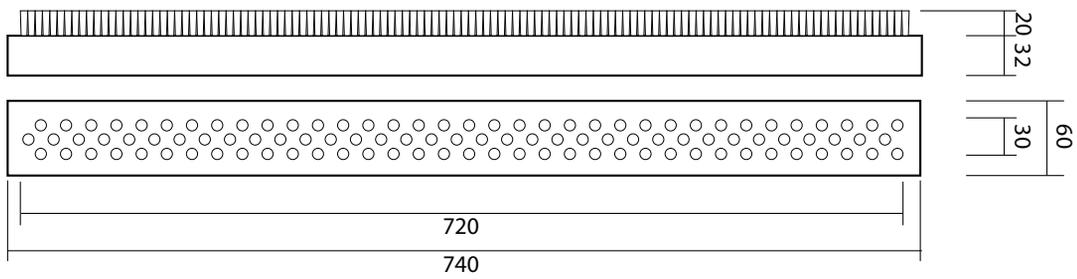
⑨ Stainless Steel Sheet 5mm



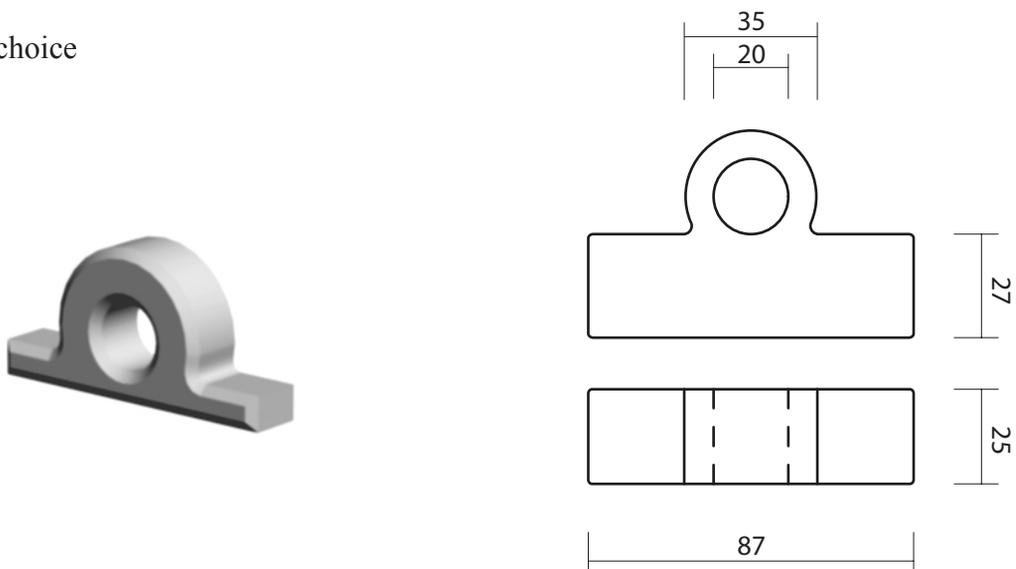
⑩ Plywood 7mm



⑪ Brush: 1 Pieces; Wood Body; Nylon Wire



⑧ Metal of choice





CHAPTER IV:  
DELIVERY



## THE TRIP BACK

Thanks to the great support from Andreas, I got the chance to take my machines to the Manaus to deliver to people in the Amazon.

Since the trip back to Amazon is just for 2 weeks, I understood that it would be impossible for me to build the machine there. I then defined my aim of this trip is to test the machine and find the ways to introduce it to many farmers as possible. That the reason I took the whole machine from Sweden to Manaus. This is also a good way for me to make sure that the machine is totally assemblable transportable.

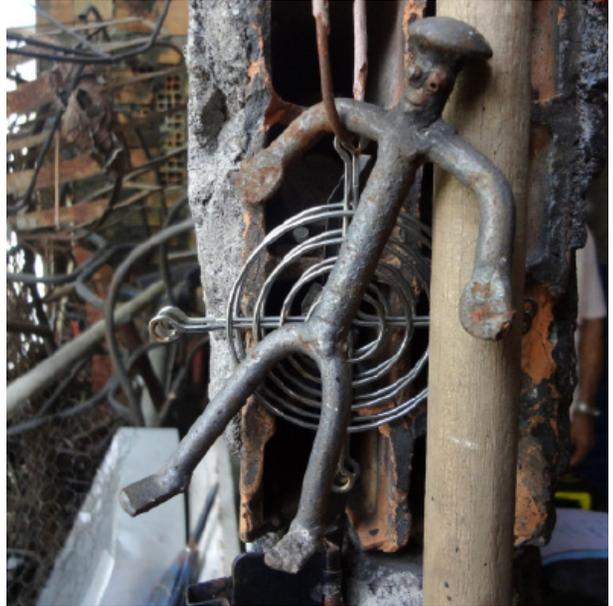
However, during the time in Manaus, I have also visited many local metal fabricators in Manaus to discuss with local blacksmiths about the possibilities of production.

I also fortunate to participate in the Agroecology Product Fair in Manaus organized by UFAM, where I had chance to meet many farmers in the whole region of Amazon. Also the machine had get interest from many Engineers, Professionals, Teachers, and Students. Most of people found the machine a really good solution, and show the expectation of having it soon in the future. Some of them ask when and where they can buy the product while others asked if they can have the instruction to build the machine themselves.



## LOCAL METAL FABRICATORS





## AGROECOLOGY PRODUCT FAIR / MANAUS





## THE MACHINE HAS ARRIVED

I finally could manage to take the machine to people in the village, where I carried out my research in March. Johanna took her Pump and I with my Cassava Peeling Machine. July is flooding season so the whole village almost was covered by water. It was quite lucky that just 2 weeks before, the water covered all over the houses, about 50cm above the floor, but when we arrived the level of the water was down quite much, so I could arrange a place to display and show the machine to people.

The testing went really well that got many interests from people in the village. I was really happy as all of people who attended at the testing said they are really impress by the machine and they think this is a wonderful idea.

Many people were invited to try the machine, and it was really fun. People enjoyed the machine and the result was finally out of my expectation.







The testing also showed that the machine has:

- + a capacity of 60- 100kg/h (compare to 20- 35kg/h peeling by hand)
- + average percent flesh loss of 5% (compare to 25% peeling by hand)
- + average peeling efficiency of 95%





# DISCUSSION

## SOCIAL DESIGN

Approach and gain knowledge about the BoP market properly is hardly be accomplished in a short time, especially for a foreign designer it will be a total new context with a total new culture and tradition and conditions. It takes time involving in a great deal of looking, listening, learning and experiencing to ensure designers to stay relevant to local people's real needs. That the reason, although the whole design process of a Master thesis is just in about 5 months with the huge amount of workload, I think it is crucial spending several weeks for the field trip into the local area. A strong social relationship with local people in the village during the field trip allowed us to be able to get not only an insight knowledge about the culture generally but also the interested areas particularly. Having that kind of attached and trusted cooperation with local people in the Amazon region was also a nice pressure to stimulate myself to work harder and more serious than usual in order to show good intentions.

Moreover allowing enough time for establishing a attached and trusted relationship with local people based on respect and mutual understand is more than a fundamental step of the design process, it should be considered at a "social responsibility and ethical practice" point of view.

However, in other aspect, I think a social design should be thought of as more than humanitarian, charity, aid, help or volunteerism, etc. but a professional contribution that plays a vital role in local, national, global development and well being. Instead of considered the target groups are as mere objects of study, designers should treat them as target clients and therefore professionally do the job finding the best solution to fulfill their identified desires.

## FROM VISION TO VALUE

Since there has been that growing interest about designer's role in socially responsible designs, it is believed that designers through their designs can contribute a significant positive impact to society. However great concepts and great vision are not enough to make an effect impact. The core value of design for social ultimately is to bring the tangible solutions to and show that it would work in the hands of actual customers.

That the reason, thanks to the support from Andreas, the delivery phase could be executed. It was great to see the prototype testing well, for me there is no award could be more honourable and meaningful than the appreciation from the people in the village.

The importance for next step is to build an appropriately action plan such as develop basic distribution channels and business models and value chains. In order to do that it is necessary to get the involvements of foundations, social entrepreneurs, NGOs, professors, consultants, etc.

So far, I am really glad to get many interests from people in the field about the project and the prototype. This is giving me a high hope that soon the machine will be introduces widely. For example, there is a request from one consultant who is working with IFAD on Agricultural Development in African for a pilot in Africa. We are now on the stage to discuss with some local partners like NGOs and IFAD for the collaboration. First of all, we are considering to place 4- 6 prototypes for testing in Ivory Coast and Ghana. Exploring the possibility about locally producing and then training on producing will be follow up. Go further, 20 more prototypes will be tested in different countries.

## REFERENCES

- \*Dev Patnaik and Robert Becker (1999). Needfinding: The Why and How of Uncovering People's Needs.
- \*J.C. Diehl and H.H.C.M. Christiaans / The First Learning Experience of Designing for the BoP
- \*Larsson, Tobias ; Larsson, Andreas ; Kassfeldt, Elisabet (2005). Innovations for Life : Design for Wellbeing
- \*Prahalad, C. K. and S. L. Hart (2002). The fortune at the bottom of the pyramid
- \*The Market at the Bottom of the Pyramid / C.K. Prahalad . May 9, 2005
- \*Nicole Nelson (2010). Sustainable Horticultural Crop Production in Brazil
- \*Gilvan Guedes, Anne Resende, Álvaro D'Antona, Eduardo Brondízio, Rodrigo Penna-Firme, Igor Cavallini (2009). Poverty dynamics and income inequality in the eastern Brazilian Amazon: a multidimensional approach
- \*Christine Nielsen (2008). Understanding key factors in social enterprise development of the BOP: a systems approach applied to case studies in the Philippines.
- \*Allen Hammond, William J Kramer, Julia Tran, Rob Katz, Courtland Walker (2007). The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid.
- \*C.K. Prahalad (2005) The Market at the Bottom of the Pyramid
- \*Dennis A. Pitta, Rodrigo Guesalaga and Pablo Marshall (2008). The quest for the fortune at the bottom of the pyramid
- \*Antoinette M.G.A. Winklerprins (2002). Seasonal floodplain- upland migration along the Lower Amazon River
- \*Bagher Emadi, Vladis Kosse, Prasad Yarlagadda (2005). Experimental investigation of abrasive peeling of pumpkin
- <http://www.wri.org/publication/the-next-4-billion>
- <http://catapultdesign.org/recent-blogs/5myths>
- <http://www.triplepundit.com/topic/bottom-of-the-pyramid/>
- [http://www.baseofthepyramid.nl/index\\_en.html](http://www.baseofthepyramid.nl/index_en.html)
- <http://www.brinq.com/resources/bop>

<http://designthatmatters.org/portfolio/our-process/>  
[http://www.its.caltech.edu/~e105/index\\_files/Page1228.htm](http://www.its.caltech.edu/~e105/index_files/Page1228.htm)  
[http://www.its.caltech.edu/~e105/index\\_files/Page498.htm](http://www.its.caltech.edu/~e105/index_files/Page498.htm)  
<http://www.ariautowers.com/html/manaus-brazil-our-neighborhood.asp>  
[http://myfundi.co.za/e/Rain\\_forest\\_people](http://myfundi.co.za/e/Rain_forest_people)  
<http://www.worldconcern.org/issues/>  
<http://joshweinstein.wordpress.com/page/2/>  
[http://www.cassavabiz.org/postharvest/3a\\_phequip.htm](http://www.cassavabiz.org/postharvest/3a_phequip.htm)  
<http://www.fao.org/docrep/X5415E/x5415e05.htm>  
[http://www.bbc.co.uk/worldservice/specials/1533\\_amazon/index.shtml](http://www.bbc.co.uk/worldservice/specials/1533_amazon/index.shtml)  
<http://news.bbc.co.uk/2/hi/americas/8702891.stm>  
<http://www.everyculture.com/Bo-Co/Brazil.html#b>  
<http://www.ruralpovertyportal.org/web/guest/country/home/tags/brazil>  
<http://archaeology.about.com/od/caterms/qt/cassava.htm>  
<http://www.bop-research.org/index.php/en/sources-of-innovation> [http://www.imtfi.uci.edu/imtfi\\_bibcritique](http://www.imtfi.uci.edu/imtfi_bibcritique)  
<http://www.slideshare.net/Ashishjha/fortune-at-the-bottom-of-pyramid>  
<http://inhabitat.com/nyc/design-with-the-other-90-focuses-on-cities-social-impact-and-sustainability/design-for-the-other-90-12/?extend=1>  
<http://www.bikesatwork.com/hauling-cargo-by-bike/gearing-and-gear-inches.html>  
<http://nextgenerationbop.com/home-3/endorsements/>  
<http://www.jumpassociates.com/needfinding-the-why-and-how-of-uncovering-people%E2%80%99s-needs.html>  
<http://www.potatobusiness.com/index.php/joomla-license/35-technology/217-advanced-peeling>  
<http://www.freepatentsonline.com/3745914.html>  
<http://www.potatobusiness.com/index.php/joomla-license/35-technology/217-advanced-peeling>  
<http://www.fao.org/docrep/X5415E/x5415e01.htm>

Photos:

<http://www.mayapedal.org/>

[http://www.electronclub.org/doku.php?id=groups:glasgow\\_fablab](http://www.electronclub.org/doku.php?id=groups:glasgow_fablab)

<http://www.woodaddywaffles.com/category/news/>

<http://www.lowtechmagazine.com/2011/05/pedal-powered-farms-and-factories.html>

<http://www.lowtechmagazine.com/2011/05/history-of-pedal-powered-machines.html>

<http://tracihappy123.en.nobodybuy.com/pid421472/cassava-peeling-machine-cassava-peeler-m.htm>

[http://www.alibaba.com/product-gs/462021627/cassava\\_peeler\\_peeling\\_machine.html](http://www.alibaba.com/product-gs/462021627/cassava_peeler_peeling_machine.html)

<http://www.proda-ng.org/products.html>

[http://www.cassavabiz.org/postharvest/3a\\_phequip.htm](http://www.cassavabiz.org/postharvest/3a_phequip.htm)

<http://www.trmodern.com/food-process-machine-more.php>

<http://io9.com/5900467/1000+year+old-farming-secrets-could-save-the-amazon-rainforest>

<http://ewater.ru/udivitelnye-fotografii-sliyaniya-rek/>

[http://www.oisat.org/crops/staple\\_food/cassava.html](http://www.oisat.org/crops/staple_food/cassava.html)

<http://www.flickr.com/photos/msgomes/107453088/>

[http://www.cidaverde.com/porteira/colunaporteira\\_txt.php?id=20046](http://www.cidaverde.com/porteira/colunaporteira_txt.php?id=20046)

<http://www.pulsarimagens.com.br/details.php?tombo=03SR318&search=mostviewed>

[http://www.pulsarimagens.com.br/details.php?tombo=15RR476&search=PA&ordem\\_foto=87&total\\_foto=251](http://www.pulsarimagens.com.br/details.php?tombo=15RR476&search=PA&ordem_foto=87&total_foto=251)







THANK YOU!

