

Material for 2nd year agroforestry students

Program- Agro forestry

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Course Title - Agroforestry and Non-timber forest products

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CHAPTER-1

Concepts of Agroforestry and forest products and services

1.1. Concepts and definitions of Agro forestry

Cont...

- Agroforestry is the art and science of growing woody and non-woody plants together on the same unit of land for range of benefits.
- Agroforestry is the use of land for a combination of agriculture and forestry or the practice of growing tree crops or some other fast growing trees along with the main crop.
- It is one of the important sustainable land management techniques, involving a combination of different agricultural, horticultural, forestry, and livestock practice. Sometimes it is closely related to ***community forestry*** and ***homestead forestry***.

Cont...

• **Agroforestry** is a collective name for land use systems and technologies where **woody perennials (trees, shrubs, palms, bamboo etc...)** **are deliberately grown on the same land management unit as agricultural crops and/or animals either in spatial mixture or in temporal sequence.**

• There must be **significant ecological and economical interactions between the woody and non-woody components**".

• Different species of trees can be planted with many types of crops in a variety of patterns. **For example, fast-growing trees can be planted when the land is fallow or they can be grown at the same time as agricultural crops**

Cont...

- **This definition implies that (characteristics):**
 - ✓ Have multiple plant components, at least one of which must be a woody perennial. Components of the system are either ecological and/or economical.
 - ✓ Usually multiple products, often of different categories (e.g. food, fodder, fuel wood). Additionally, it promotes soil and water conservation, enhances soil fertility, and act as windbreaks for nearby crops.
 - ✓ The cycle of an agroforestry system is always more than one year and
 - ✓ The simple agroforestry system is more complex, ecological (structurally and functionally) and economically, than a mono-cropping system.

1. 2. Agroforestry Products

- Agroforestry products are includes all the products which gained from: Agriculture, Pasture and Agroforestry tree products.
- Some of the products gained from practicing agroforestry described on the following tables:

Characterization of agroforest products

	Categories	Description
Agroforest ry Tree products	Food	Vegetal foodstuff and beverages provided by fruits, nuts, seeds, roots
	Fodder	Animal and bee fodder provided by leaves, fruits etc.
	Medicines	Medicinal plants (e.g. leaves, bark, roots) used in traditional medicine and/or by pharmaceutical companies
	Perfumes & cosmetics	Aromatic plants providing essential (volatile) oils and other products used for cosmetic purposes
	Dying & tanning	Plant material (mainly bark and leaves) providing tannins and other plant parts (especially leaves and fruits) used as colorants
	Utensils, handicrafts	Heterogeneous group of products including thatch, bamboo, rattan, wrapping leaves, fibres (e.g. Arouma, Bwa Flo, Silk cotton floss, Screw pine)
	Construction materials	thatch, bamboo, fibres,
	Ornamentals	Entire plants (e.g. orchids, ferns, philodendron) & parts of the plants (e.g. pots made from roots) used for ornamental purposes
	Exudates	Substances such as gums (water soluble), resins (water insoluble) & latex (milky or clear juice), released from plants by exudation
Animal products		Milk, honey, bee wax, meat and etc
All Crop products		For different purposes like, food,

Characterization and definition of AFP

Definitions

- Agroforestry Products (AFPs) are the whole range of **products and services** obtained from animals, crops and tree components growing together in spatial or temporal association in an agroforestry system of diversity of ecological conditions. Ecosystem services from agroforestry:
- *benefits like provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits.
- Agroforestry Tree Products (AFTPs) refers to timber and non-timber forest products that are sourced from trees cultivated outside of forests.

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- Distinction from the term timber forest products (NTFPs) for non-timber extractive resources from natural systems is to distinguish between extractive resources from forests and cultivated trees in farming systems.
- Nevertheless, some products will be marketed as both NTFPs and AFTPs (depending on their origin) during the period of transition from wild resources to newly domesticated crops (Simons and Leakey, 2004).

Characterization of AFP ...

Different wood products of AF

- Timber trees eg Cordia, prunus, podo
- leguminous trees
- parkland/shade trees eg acacia, ficus trees
- Fodder trees

Crops

- Maize
- Coffee
- Chat
- Root crops
- Spices
 - Ginger
 - Cardamom

Cont...

Edibles

- Mushrooms
- Nuts
- Fruits
- Berries

Medicinals

- Jatropha
- Brucea
- Prunus, Myrrh

Services

- Cultural
- Lesiure and tourism
- conservation

1.3 .Attributes of agroforestry

•There are three attributes which theoretically all agroforestry systems possess, these are:

1. **Productivity:** most, if not all, agroforestry systems aim to maintain or increase production (of preferred commodities) as well as productivity (of the land).
- Agroforestry can improve productivity in many different ways. These include: increased output of tree products, improved yields of associated crops, reduction of cropping system inputs, and increased labor efficiency.

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2.Sustainability: by conserving the production potential of the resource based, mainly through the beneficial effects of woody perennials of soils, Agroforestry can achieve and indefinitely maintain conservation and fertility goals.

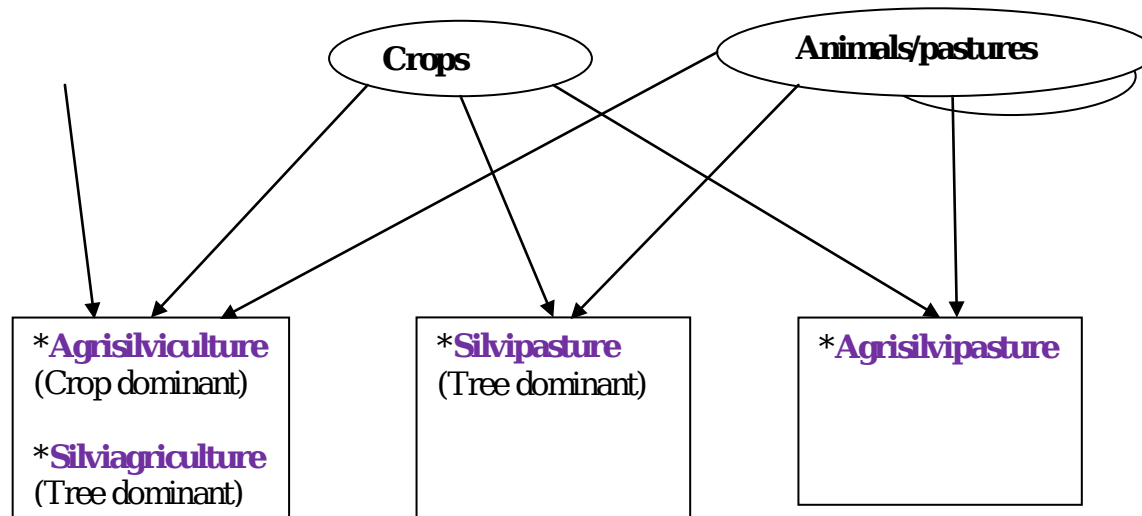
3.Adoptability: the Word, adopt” here Means, accept”, and it may be distinguished from another commonly-used word adapt, which implies, modify” or, change”. The fact that agroforestry has already been accepted by the farming community.

However, the implication here is that improved or new agroforestry technologies that are introduced into new areas should also conform to local farming practices.

Components of Agroforestry

- There are three major components in agroforestry system. These are:
 - 👉 Tree or woody perennials, Crops, Animals

Fig1.1.agroforestry components combination.



1.4. NTFPs definition and classification

- * **NTFPs include** all botanical and other natural products extracted from forest ecosystems other than timber.
- ⇒ It include plants and plant materials used for **food, fuel, fodder, medicine, cottage and wrapping materials, biochemical**, as well as **animals, birds, reptiles and fishes**, for food and feather.
- ⇒ NTFPs which are harvested from within and on the edges of natural and disturbed forest, may be all or part of a living or dead plant, lichens, fungi, or other forest organisms.

NTFPs Vs NWFPs:

- ⇒ **Non-wood forest products(NWFPs)** - excludes all woody materials such as timber, chips, charcoal, fuel wood and other small woods used for tools and household equipments.
- ⇒ **NTFPs** - are not necessarily non-wood products, but excludes industrial wood.
- NTFPs of economic importance in Ethiopia are: natural gums and incenses, wild coffee, bamboo, herbal medicine, fuel wood, small-diameter wood used for poles, posts and carvings, honey/bee wax, spices and condiments, civet musk, and forest food (Plant & Animal)

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- A globally applicably **standard classification system** for NTFPs does not exist (Shiva & Verma, 2002).
- However, NTFPs can be classified in many different ways:
- Accordingly NTFPs can be classified into different **categories based, on the purpose of use** (for example, as food, fuel, medicine, house hold utensils, farm implements); **level of use (self supporting, commercial); the part of plants harvested** (leaf, fruit, stem ,roots) and trophy from wild animals.

Table 2. Categories of NTFPs and AFTPs

Product category	Examples
A. Plant products	
Food	Edible seeds, fruits, nuts, leaves, roots. Stems, shoots etc. e.g. Moringa,
Forage/fodder = forest grazing	Plants grazed or browsed by animals
Construction material	Bamboo , rattan, grass for roofing, liana, etc.
Fuel	Fire wood, charcoal
Medicinal products	Herbs, and plant parts for TM or pharmaceutical application
Utensils	For handcraft, stools fibers for basketry and cloth
Biochemical	Non-edible fats and oils, waxes, gum, latex, dyes, etc
Aromatics	Essential oils for cosmetics and perfumes, incense
Ornamentals	Flowers, garden plants
B. Animal products	
Food	Meat and protein
Forage	Fish oils, bones
Medicinal products	
Utensils	Horns, skins,
Biochemical	Wax, silk, toxins
Ornamentals	Live animals, feather, hides, skin, shells

1.5.Relation between AFTP and NTFPs

- Agroforestry tree products and non timber forest products provide different products to consume and to generate income.
- These products include foods, fodder, medicines, spices, resins, dyes, construction materials, fuel wood, and utensils.
- They are also important for food security, health, and social and economic welfare of rural communities.
- They provide a significant nutritional contribution, especially crucial during times of drought and famine, create more varied, palatable, and balanced diets as well as to reduced risks and diversified sources of income to buffer against crop failure.

1.5.1.Linkage between domestication and commercialization of products.

What is Domestication?

- ❖ Domestication is the process of naturalization of plant species towards specific human-induced growing conditions.
- ❖ Domestication of any plant species is concerned with selection and management by humans.
- ❖ The domestication of natural resources involves a move from gathering in the wild on communally owned land to the deliberate cultivation of NTFPs on tenured farm lands.

Why we need to domesticate wild forest resources in agroforestry?

- ✓ The domestication of agroforestry trees should enhance their capacity by fulfills either or both of these **service or production functions**.
- ✓ It also aim at increasing the social and economic benefits of agroforestry, through **improved profitability, reduced risks and diversified sources of income to buffer against crop failure**. This will act as an incentive for adoption by farmers.

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- ✓ The other potential benefit of agroforestry is that of the diversification of species grown on farm. Through this, and the domestication of an increasing number of tree species, it should be possible to make smallholder farming both more biologically diverse and more rewarding economically.

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- ✓ subsistence purposes
 - ✓ The need to boost supply to meet demand
 - ✓ Improvements in For quality and yields, and
 - ✓ The wish to bring the resource closer to the harvesters
- ⇒ So, different degree of domestication exists;
and is desirable

Cont..

- ❖ **When the value of NTFP & intensity of exploitation is low,**

- ⇒ Human impacts on NTFPs are likely to be minimal; and

- ☐ Little or no formal management of the resource is required..... (No domestication is needed)

- ❖ **When the value & the intensity of its use are extremely high,**

- ⇒ It's highly likely that the resource is being over- exploited; and is threatened with local extinction.

- ☐ In such cases, **substitution or domestication** may be the only way to conserve the wild resource without adversely affecting local livelihoods.

- ❖ With this regard, domestication of the forest environment involves various phases:

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- **First phase:** change from uncontrolled utilization of wild tree products to their controlled exploitation.
 - **Second phase:** purposeful cultivation of wild trees
 - Either in a resource enriched natural environment, or in an indigenous agro forestry system such as forest gardens.
 - **Third phase:** The cultivation of domesticated trees in either agro forestry systems or commercial tree-crop plantations
- ❖ In the first stage of domestication of the forest environment,
- The management practices are directed at defining user rights.
- ❖ In the second and third stages' besides the issue of defining user's rights, the management practices also focuses on the tree resources.

Cont...

- This focuses on the manipulation of the growing conditions of the trees and the trees' morphological characteristics.
- ❖ These three stages of domestication processes are associated with specific socio-economic and ecological conditions.
 - And, the focus of management practices also differs.
- ❖ The recognition of various phases of forest and tree domestication provides better understanding of;
 - The different options for the production of commercial tree crops in agro forestry systems, under specific conditions of time and location.

Cont..

- **Commercialization:** is the development of a product or service that is suitable or fit for a wide public market.
- It is one's intent to profit by commercialization.
- This may or may not be true for domestication.
- Together, domestication and commercialization may lead to monocultures.
- While monocultures may not be desirable from a diversity perspective, they may be economically, and perhaps environmentally, acceptable.
- Agroforestry systems may be more diverse and environmentally acceptable, but they are not necessarily as productive and profitable as plantations.
- However, if the environment and the external benefits are costed, agroforestry systems may be the most beneficial in the long run.

Cont...

- ✓ To commercialize, it is necessary to have or create a demand. One should show that the product
 - o is better or more economical than available alternatives
 - o is good for the user
 - o makes the user feel good
 - o makes the user look better
 - o is rare or unique or different
 - o makes the user one of the crowd

1.5.2 Tradeoff between agroforestry and NTFP production

- ✓ These economically viable, biologically diverse systems suggest that agroforestry can produce NTFPs commercially and in a sustainable way.
- ✓ If we can Linkages between domestication and commercialization understand the set of circumstances, including the policy environment, estimation of demand, analysis of supplies, and assessment of problems and economics of transportation.
- ✓ It may be possible to introduce domesticated trees into agroforestry systems to produce NTFPs for national and international markets without industrial pressures converting them to monocultures.
- ✓ In other words, the evolution of the domestication process can perhaps be stopped before the step into plantations.

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•**NB.** To encourage farmers to manage trees in agroforestry systems, the following would be needed:

- ⇒ Security of tenure
- ⇒ Guaranteed benefits
- ⇒ Access to credit
- ⇒ Access to appropriate planting material
- ⇒ Access to technologies for production and processing
- ⇒ Access to training (processing, entrepreneurship, etc.)
- ⇒ Access to markets (demand creation, market information systems)
- ⇒ Creation of awareness of value of projects at all levels
- ⇒ Partnerships in project activities

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• **Lack of market information is the key barrier into NTFPs trade**

- o Information about markets, together with the capacity to act upon it, is an important prerequisite for entering, and maintaining a hold in, new markets.

Key findings include

- o :A lack of market contacts and knowledge, followed by lack of financial capability and poor infrastructure, consistently constrains poor producers, processors and traders from advancing within NTFP value chains.
- o The real value of market information lies in ensuring that the commercialization process is equitable, efficient and sustainable.

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- o Good organization of NTFP producers and processors contributes to improved product quality and quantity, more cost-effective transportation and increased negotiating ability.
- o Access to credit can enable poor people to improve their NTFP-based income generation through increased volume of trading.
- o General improvements in market transport and communications infrastructure would facilitate commercialization of many products, including NTFPs.
- o There is no significant difference in formal education between households engaged in NTFP commercialization and those that are not, although NTFP traders often have significantly higher levels of education than producers.
- o Traditional knowledge can be very important in determining a community's interest and capacity to successfully commercialize an NTFP.

Chapter-2

Mushroom production in agro forest and forest ecosystem

2.1.definition, Ecology classification and distribution

- Mushrooms are the fruiting bodies of certain types of fungi,
- many of which can play highly beneficial roles in forest ecosystems.
- Many of these fungi have **unique** abilities to break down wood, leaves, and other organic matter and recycle nutrients back into the system.
- Mushrooms are devoid of leaves, and of chlorophyll-containing tissues. This renders them incapable of photosynthetic food production.
- Yet, they grow, and they produce new biomass.

Cont...

- For their survival, for their growth, and for their metabolism, they rely on organic matter synthesized by the green plants , including organic products contained in agricultural crop residues.
- The organic materials, on which mushrooms derive their nutrition, are referred to as **substrates**.
- There are hundreds of identified species of fungi which, since time immemorial, have made a significant global contribution to human **food and medicine**.
- Some estimate that the total number of useful fungi – defined as having **edible and medicinal value – are over 2 300 species**.

Cont...

- Cultivated mushrooms have now become popular all over the world. There are **over 200 genera of macro-fungi** which contain species of use to people.
- **Twelve species are commonly** grown for food and/or medicinal purposes, across tropical and temperate zones, including the Common mushroom (*Agaricus*), Shiitake (*Lentinus*), Oyster (*Pleurotus*), Straw (*Volvariella*), Lion's Head or Pom Pom (*Hericium*), Ear (*Auricularis*), Ganoderma (*Reishi*), Maitake (*Grifola frondosa*), Winter (*Flammulina*), White jelly (*Tremella*), Nameko (*Pholiota*), and Shaggy Mane mushrooms (*Coprinus*).
- Commercial markets are dominated by *Agaricus bisporus*, *Lentinula edodes* and *Pleurotus* spp, which represent three quarters of mushrooms cultivated globally.

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⇒ Three basic ecological groups of mushrooms:

- a. Saprophytes:** which do not need living hosts & colonize dead organic matter that they decompose, they are hence involved in nutrient recycling, Saprophytic mushrooms can thus occur in agricultural land, in pastures, and of course in woodlands and forests.
- b. Symbiotic:** living together with other organisms (especially trees) in a close, mutually beneficial relationship. For instance, a sheath of hyphae wraps around the root, and they penetrate the root structure but not the actual root cells themselves, and forming a living contact between the fungus and the tree.
- c. Parasites:** living at the expense of other organisms

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- When edible and medicinal mushrooms are involved as key organisms in agriculture and forestry,
 - the productivity of these agricultural systems can soar to extraordinary levels.
 - mushrooms are protein-rich food source for humans but the byproducts of mushroom cultivation unlock nutrients for other members of the ecological community.
- The rapid return of nutrients to the ecosystem by mushrooms boosts the life cycles of plants, animals, insects (bees), and soil microflora.

Cont...

- Mushrooms can play highly beneficial roles in forest ecosystems. Many of these fungi have unique abilities to break down wood, leaves, and other organic matter and recycle nutrients back into the system.
- Most plants depend on symbiotic relationships with certain types of fungi such as mycorrhizae.
- Other types of fungi support plants indirectly by releasing enzymes into the environment, making nutrients available, and performing many other functions.
- Fungi can be a great asset to a farm system, both for their ecological services and for their valuable edible and medicinal products.

2.2. Identification of edible and poisonous fungi

- Many macro-fungi are not worth eating or are simply inedible
- This worthless group of species – as defined by their edibility – significantly dwarfs the very small number of toxic or poisonous species, of which there are only a very few that can kill.
- *Knowing the scientific name* of a fungus provides a good indication of its edibility.
- The only reliable guide to edibility is the knowledge that someone has eaten a particular type – and survived.
- *Therefore Local practices and preferences* (*Knowing the scientific name*) are therefore another useful source of information.

2.3. Cultivation of edible fungi

- There is increasing experimentally based evidence to support centuries of observations regarding the nutritional and medicinal benefits of mushrooms.
- From the world production figures, it is evident that *Agaricus bisporus* contributes about one third of the total production followed by *Shiitake* and *Pleurotus species*.
- Some years earlier, the trend and the demand of oyster and wood ear mushrooms have shown appreciable increase.
- In most cases, the total production of different species of mushrooms has increased more than 5 times during the last 20 years (Tripathi, 2005).

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- Now a day, mushroom is being cultivated in more than 100 countries with an estimated annual product of around 6.6 million tons.
- The Europe shares about **55%**, North America about **27%** and Eastern Asia produces about **14%** of world production.
- Remaining percentage of mushroom is produced in other parts of the world (*Tripathi, 2005*).

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- Mushrooms can be grown by anyone, from backyard gardeners to large-scale corporations.
- They do not require arable land, special light, or large amounts of water. Many mushrooms do not compete with other plants, and even enhance the growth of many plants. Mushrooms can be cultivated in agar, boiled straw, compost, on logs and stumps, even in the lawn.
- They can be grown outdoors or indoors. "Just-add-water" kits or spawn raised under laboratory conditions are available.
- The ***mushroom life cycle is not only shorter than many crops*** (six to seven weeks for one shiitake crop), but the ***yield is very high***.

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• **Why mushrooms cultivation for Ethiopia?**

- ✓ Converting inedible plant biomass to nutritious food
- ✓ Requires little land and does not require light
- ✓ Production throughout the year
- ✓ The use different raw materials for growth (agricultural and agro industrial waste)
- ✓ Short production period (short live cycle with high production)
- ✓ Manpower intensive
- ✓ High value international crop with growing global market

Cont...

• **Cultivation Technology (procedure for cultivation mushroom)**

- ✓ Selection of mushroom type
- ✓ Facility for quality spawn or supplier of spawn
- ✓ Evaluation of available raw materials
- ✓ Controlling environmental conditions
- ✓ Construction of appropriate growing houses
- ✓ Management of pests & diseases
- ✓ Processing and marketing

Key steps in mushroom production

•The basic concept in cultivation is to start with some mushroom spores, which grow **into mycelium and expand into a mass sufficient in volume and stored up energy to support the final phase of the mushroom reproductive cycle**, which is the formation of fruiting bodies or mushrooms.

•The key generic steps in mushroom production – a cycle that takes between one to three months from start to finish depending on species – are:

1. identifying and cleaning a dedicated room or building in which temperature, moisture and sanitary conditions can be controlled to grow mushrooms in;
2. choosing a growing medium and storing the raw ingredients in a clean place under cover and protected from rain;

Cont...

- 3 .pasteurising or sterilizing the medium and bags in which, or tables on which, mushrooms will be grown (to exclude other fungi that would compete for the same space - once the selected fungi has colonized the substrate it can fight off the competition);
- 4 .seeding the beds with spawn (spores from mature mushrooms grown on sterile media);
5. maintaining optimal temperature, moisture, hygiene and other conditions for mycelium growth and fruiting, which is the most challenging step; adding water to the substrate to raise the moisture content since it helps ensure efficient sterilization;
6. harvesting and eating, or processing, packaging and selling the mushrooms;
7. Cleaning the facility and beginning again.

2. 4.Main varieties of cultivation

- Presently, mushroom farming is being practiced in more than **100 countries**.
- its production is increasing at the rate of **7 per cent per annum**.
- Production of mushroom has already crossed 6.6 million metric tons annually in the world and is expected to reach around 7 million metric ton in the next ten years (Bhupinder and Ibitwar, 2007).

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- The main cultivated mushrooms species in the world are the following
 - ✓ Oyster (*Pleurotus ostreatus*) mushroom
 - ✓ Shiitake (*Lentinula edodes*) Mushroom
 - ✓ Button Mushroom (*Agaricus bisporus*) Mushroom
- Button contributes about one third of the total production followed by Shiitake & Oyster species in the world.
- These species are also the main cultivated mushrooms but in small scale in Ethiopia as well.

2.6. Resource potential and domestication of wild edible fungi

- People have harvested mushrooms from the wild for thousands of years for food and medicines.
- While commercial harvesting of wild mushrooms continues today, most of the world's supply comes from commercial mushroom growers.
- Currently there is a considerable level of awareness and interest among certain group of the society as to the importance of mushroom production in our country.
- Few mushroom growers are growing especially **oyster mushroom** in Addis Ababa, which is an indication of the products good future .

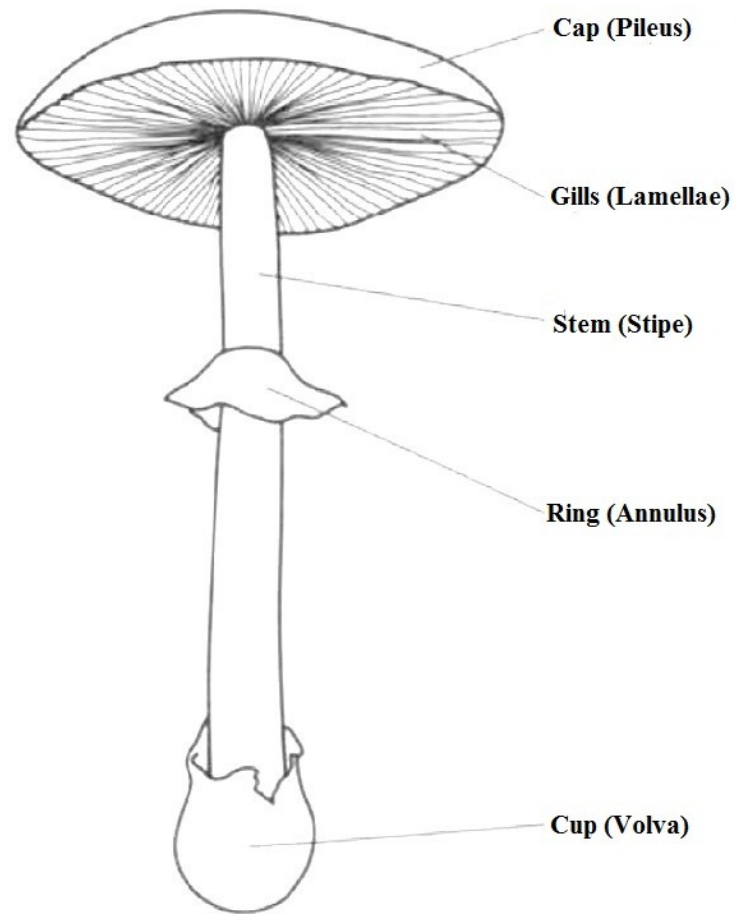
2.6. Management of fungi resources

- The management of wild edible fungi and their sustainable production must address two key topics: first, **forests and their management** and second, **forest users**.
- Successful management of wild edible fungi balances the impact and effects of collection and harvesting against the wider aims of forest management.
- Managing forest ecosystems to conserve fungus diversity and sustain wild mushroom harvest.
- For instance, restoration and rehabilitation mechanisms, sustainable utilization of the resources are the main one.

Cont...

- Generally, if we manage the natural resources (forest) indirectly we are going to manage our fungi resources because natural resources (forests) are serving as a habitat for most fungi species.
- Management of wild edible fungi has tended to concentrate on **their biology and ecology**, particularly those of high economic value.

Parts of mushroom



Chapter 3

Bamboo: a multipurpose forest and agro forest product

3.1.Extent and characteristics of Bamboo Resources

Cont...

- Bamboo belongs to the *Gramineae* family and has about 111 genera with over 1575 species.
- Bamboo is naturally distributed in the tropical and subtropical belt between approximately 46° north and 47° south latitude, and is commonly found in Africa, Asia and Central and South America.
- Bamboo is an extremely diverse plant, which easily adapts to different climatic and soil conditions.

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- Bamboo shoots and culms grow from the dense root rhizome system.
- There are ***two main categories of rhizomes:***
monopodial and sympodial.
- ***Monopodial rhizomes*** grow horizontally, often at a surprising rate, and thus their nickname of ***'runners'***.
- The rhizome buds develop either upward, generating a culm, or horizontally, with a new tract of the rhizomal net.
- Monopodial bamboos generate an open clump with culms distant from each other and can be invasive.

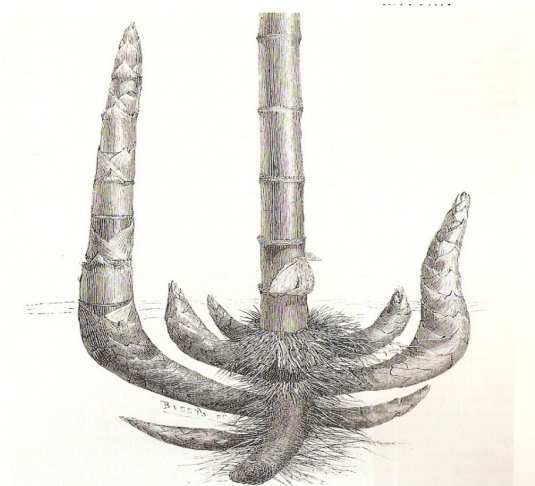
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- ***Sympodial rhizomes*** are short and thick, and the culms above ground are close together in a compact clump, which expands evenly around its circumference.
- Their natural habitat is tropical regions and they are not invasive.

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Monopodial or runner bamboo



Sympodial Bamboo or Tropical

Characteristics of bamboo

- ✓ Fast growing woody plants
 - with a growth rate ranging from 30 - 100 cm per day in growing seasons
- ✓ Bamboo not only grows much faster than wood, it also needs relatively little water
- ✓ Have light weight and suitable fiber characteristics
- ✓ Strength of bamboo culms
- ✓ Straightness
- ✓ Lightness combined with hardeners

Cont...

Its Uses

* Prevents soil erosion

- Canopy intercept of bamboo is 25% which means that bamboo greatly
 - Reduces rain run-off
 - Preventing massive soil erosion

* Thus, bamboos help control

- Landslides
- Keep flooded rivers along their natural course &
- Slow the speed of the water flow

* Bamboo has been used for a medicinal purposes

Cont...

- * Bamboo is one of the world's best natural ***engineering materials because*** it have a characteristics of quality of strength, light weight and flexibility make bamboo a viable alternative to tropical timbers which are also in short supply for furniture and building material industries.
- * As a food source, bamboo shoots have provided nutrition for million of people worldwide
- * Bamboo is also a source of energy
- * Its perfect tool for reducing CO₂ levels in the atmosphere

Cont...

Categories and definitions of bamboo resources

Category	Definitions
Natural bamboo forest	Bamboo area of naturally regenerated native bamboo species.
Plantation	Bamboo area of native or introduced species, established through planting, seeding or assisted natural regeneration.

3.2.Diversity and growing stock of bamboo resources

- Growing stock is a major indicator of the extent of bamboo resources.
- Information on growing stock is also needed to estimate bamboo biomass and carbon content.
- Growing stock is normally measured in culms (for ***mon opodial species***),
 - clumps (for ***sympodial species***) and weight (for both types of species).
- Coefficients exist for the different species to convert number of culms and clumps to fresh and dry weight.

Categories and definitions about bamboo growing stock

Category	Definitions
Bamboo Growing stock	Weight (tons) of all bamboo forest more than X cm in diameter at breast height.
Commercial growing stock of Bamboo	The part of the growing stock of bamboo species that are considered as commercial or potentially commercial under current market conditions, and with a diameter at breast height of Z cm or more. The definition of bamboo commercial growing stock varies from country to country.
Growing stock of Common bamboo species	Weight (tons) of the most common bamboo species.

3.3. Agroforestry functions

- ❖ Bamboos biological characteristics make it a perfect tool for solving many environmental problems.
 - erosion control and CO₂ sequestration.
- ❖ On account of extensive rhizome-root system and accumulation of leaf mulch, bamboo serves as
 - preventing soil erosion,
 - conserving moisture
 - reinforcement of embankments and drainage channels
 - generates plenty of oxygen,
 - lowers light intensity
 - protects against U-V irradiations and is an atmospheric and soil purifier.

3.4. Potential of bamboo for market and conservation in Ethiopia

♣ Ethiopia has two indigenous bamboo species:

The highland bamboo

(Arundinaria alpina; Yushania alpina)

Low land bamboo

(Oxythenantera abyssinica)

- Although bamboo is not an integral part of the economy of Ethiopia, it plays a very important role socially, economically and ecologically in areas where it occurs naturally and where it is planted.
- Both the highland and lowland bamboos are such a versatile type of resources that they can be used in many ways.

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- The country should have potential to generate an approximate of 9.5 billion birr annually. Bamboo culms are versatile in application and can be used in numerous industrial and local applications.
- It would be possible to harvest one third of the total stock every year on sustainable basis (3 million tones of oven dry biomass).

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3.5. Harvesting of bamboo

The following rules apply for harvesting culms of bamboo

- Harvesting of mature culms may begin 5 to 6 years after planting.
- Harvest culms only during the **dry season**. The starch content of bamboo is lower during periods of dryness. Lower starch content in the culms will make them **less susceptible to attack by borers**.
- Harvesting should be **selective**:
- Harvesting of culms therefore should be from the **center** (mature culms) and **not at the periphery** (soft culms) of the clump.

A few older culms should be left in the clump after

Post-harvest Treatment of Bamboo

- o **Bamboo culms** are vulnerable to decay and attack by fungi or insects, especially powder post beetles, termites,. Such attacks reduce the natural durability of bamboo and diminish their value and utility.
- o **Post-harvest treatments** can help to reduce the risk of decay and attack by pests and thereby increase the useful life and value of bamboo culms.
- o Depending on the end use of the culm, several methods of preservation may be applied to culms prior to their sale or industrial utilization.

Methods of preserving bamboo

1, **Drying and Seasoning**

After harvesting, the culms are left in the field for some time with branches and leaves intact. The transpiration of moisture through the leaves contributes to the reduction of starch in the culm.

2, Smoking: The bamboo culms are cut into the desired length and stacked above a fire in an enclosed area. The smoke causes the culms to blacken and the heat destroys the starch in the parenchyma cells. Bamboo culms cured with smoke are known to last more than 15 years.

3, Construction methods: mounting bamboo poles over a concrete or stone foundation helps prolong their service life. Since the bamboo is not in contact with the ground, it is less susceptible to attack by fungi and termites

4, Fumigation: involves the use of chemicals such as **Methyl bromide** for insect control

Brainstorming: Activity 1

When do you think people started using plants?

- ✓ **Can you mention some of the benefits of plant species for mankind?**

Cont'd...

- For millennia, human beings relied on MAPs to satisfy their **Primary Health Care needs**
- **MPs- Herbal medicine**
 - ⇒ **MAPs** have high content of **active ingredients/** substances with very specific chemical, biochemical used to cure disease or **relieve pain**
 - Therapeutic purposes (medicinal plants),
 - Aromatic purposes (aromatic plants or essences), &
 - Dietetic purposes (condimental plants)

Cont'd...

- ⇒ **MAPs** can be defined as botanicals that provide people with medicines – to prevent disease, maintain health or cure ailments.
- ⇒ The basis for this use is that these plants contain so called active ingredients that affect physiological (metabolic) processes of living organisms, including human beings.
- ⇒ The specific part of medicinal plant such as **root**, leaf, stem, flower, which is used for therapeutic purposes, is known as **Vegetal drug**.

Cont'd...

- **Essential oil-** Volatile oil usually having the characteristics of odour & flavor produced by plants... used for flavoring & perfumes
- Globally the estimate of **MPs** spp. range from **35, 000 - 50, 000** medicinal & aromatic plants are estimated to be used world-wide **from lichens to towering trees**
- Out of this about **4000 - 6000** of MAPs are traded internationally

Cont'd...

- About **15,000 MP** spp. may be threatened with extinction world-wide (IUCN Red List).
- Recently, WHO estimated that **80% of people** worldwide rely on **herbal medicines** for some part of their **primary health care**
- In Ethiopia, **MPs** have been used as **TM** to treat **different human ailments** by the local people from time immemorial
- At **least 80%** of the Ethiopian people depend on **TM** for their health care &

Cont'd...

- More than **95%** of traditional medicinal preparations in Ethiopia are made from **plant origin**
- The majority of the **MPs** are **herbs**, followed by **shrubs & trees**
- In Ethiopia **over 7500 spp.** are estimated to exist,
 - Whereby **over 1000 spp.** are assumed to offer medical value of one or another type
 - Among these, **endemic MPs** comprise about **52** taxa & most are found in the wild

Distribution of the **MPs** by their growth forms (country reports)

Growth habit	No. of species	%
Herbs	271	30.5
Shrubs	168	19.0
Trees	110	12.4
Climbers	74	8.3
Reed	2	0.2
Unidentified	-	-

Source: Tesema et al., 2003

Cont'd...

Major cultivated MPs are:- e.g.....

- ✓ Rhamnus prinoids
- ✓ Aloe spp
- ✓ Carica papaya
- ✓ Citrus lemon
- ✓ Withania somnifera

- Among the all MPs cultivated MPs covers only
13%...

Rationale for herbal medicine.....

- insufficiency of the modern health care system
- Lack of modern medicines
- High cost of medicines & medical care
- Side-effects of modern drugs
- Scientific basis for the use of plants in medicine
- Availability of most medicinal plants nationwide

Volume of MPs Harvested (country report)

56000 tonnes of MPs are used per annum.



7 000 tonnes (13%) being cultivated.



49 000 tonnes (87%) are harvested from wild



Cont'd...

Distribution of MPs by their state of existence

State of existence	No. of species	%
Wild	357	40.2
Cultivated	89	10
Weed	52	5.9
Undetermined	-	-

Sustainable collection of **MPs**

- In various parts of the world, **MPs** are mostly harvested from the wild sources either for **local use** or **trade purposes**.
- However, many of these plant species used in traditional systems are becoming **rare & limited in distribution**;
 - ✧ They are threatened by **several factors**, both man-made & natural.

Cont'd...

These are.....

- Agricultural Expansion
- Overgrazing
- Fuel wood (& wood for construction)
- Logging & fire
- Investment & resettlement
- Loss of forests & woodlands
- Civil unrest (including external & internal displacements)
- The introduction of invasive & non-invasive alien species
- Over harvesting & marketing

Cont'd...

- But nowadays, sustained & coordinated efforts are needed to transform currently unsustainable practices of **MPs** mining from wild sources to more:-
 - ✓ Ecologically sustainable,
 - ✓ Socially acceptable, &
 - ✓ Economically equitable production & utilization systems
- In fact such valuable activity requires appropriate action, & changes by the full range of **societies** & **stakeholders** involved in the:-

Cont'd...

- ✓ Conservation, production,
- ✓ Management, marketing,
- ✓ Processing &
- ✓ Use of MPs & their derivatives

- **Generally**, there are some conservation measures that have been undertaken around the world aimed at protecting threatened **MPs** spp. from further destruction

- ✓ In-situ conservation
- ✓ Ex-situ conservation

Cont'd...

In situ conservation

- Conservation of species in their natural habitat
- E.g. natural parks, nature reserves

Ex situ conservation

- Conserving species in isolation of their natural habitat
- E.g. zoos, botanical gardens, seed banks, Gene-banks

- In USA & Europe **TM** trade is growing by **10% per annum**.
- In the **year 1999** the world market for Herbal remedies was **US\$ 19.4 billion**.
- In **1996 440,000 tons** imported to Europe, Valued US \$ 3.2 billion (60 % from Africa & Asia).
- Though most still remain **TM** in Ethiopia, there are a number of patented & commercially manufactured medicines derived from plants that are also native to Ethiopia, & several others also in pipeline.

Cont'd....

- In our country, except in a few cases where a few food crops with medicinal value are cultivated,
- There is no organized cultivation of plants species for medicinal purposes.
 - ✓ Reason for this is that the quantities of **MPs** traded are very small, &
 - ✓ There is no organized large scale **value addition** & **processing**.
- ✓ Now a day the **export trade** activities of our country rely on the products of some species (includes caltha edulis & gums from various **ABC spp.**

Commonly Marketed MPs

N o	Plant	Vernacular name	Ha bit	Part used	Medicinal use
1	<i>Carissa spinarum</i>	Agam/Hagmssa	Shrub	Roots	Evil eye, epilepsy
2	<i>Croton macrostachyus</i>	Bisana/ Bakanissa	Tree	Roots	Gonorrhea
3	<i>Echinops kebericho</i>	Kebericho/ Karabicho	Herb	Rootstoc k	Abdominal problem
4	<i>Embelia schimperi</i>	Enqoqo/Hanqu	Liana/ Shr ub	Fruit- seeds	Tapeworm
5	<i>Glinus lotoides</i>	Metere	Herb	Fruit	Tapeworm
6	<i>Hagenia abyssinica</i>	Kosso/Heto	Tree	Flowers	Tapeworm

Cont'd...

8	<i>Jatropha curcas</i>		Shrub	Fruit	Evil eye, abdominal problem
9	<i>Olea europea</i> ssp <i>cuspidata</i>	Woirra/Ejersa	Tree	Bark	Renal problems/ mouth bleeding
10	<i>Plumbago zeylanica</i>	Amera	Herb	Leaves/ fruit	Various
11	<i>Rumex abyssinicus</i>	Meqmeqo	Herb	Root	Diarrhea
12	<i>Securidaca longepedunculata</i>	Itesemenah	Shrub	Roots/ bark/ leaves	Diarrhea/ various
13	<i>Silene microselen</i>	Wegert	Herb	Root	Evil eye/ tapeworm
14	<i>Taverneria abyssinica</i>	Dingetegna	Shrub	Roots/ bark/ leaves	Various/ sudden illness
15	<i>Thymus schimperi</i>	Tosegn	Herb	Leaves	Gonorrhea
16	<i>Warburgia ugandensis</i>	Befti	Tree	Bark	Malaria
17	<i>Withania somnifera</i>	Gimera	Shrub	Root	Various illness/ Evil

Withania somnifera



Zingible officinale



***Pelargonium graveolens* : Geranium**



Mentha piperita* : *Pepper mint



***Mentha arvensis* : Japanese mint**



***Cymbopogon flexuosus* : Lemongrass**



Aloe vera - Aloe



**Balanites
aegyptiaca**



bedeno, jemo, kudkuda



Datura stramonium





A landscape photograph showing a dense forest of trees with green and reddish-brown foliage covering a hillside. In the foreground, there is a grassy field. On the left, a large, gnarled tree trunk leans over. On the right, a small, simple building with a blue roof is visible. The text *Hagenia abyssinica* is overlaid in the center of the image.

Hagenia abyssinica





Chapter-5. Role of NTFPs in sustainable development

5.1.NTFPs in development & conservation

- ▶ There has been strong belief that NTFPs are **compatible** with conservation of natural forests and their biodiversity as opposed to logging for timber or conversion.

**Less destructive in harvesting;
e.g. no felling**

However, this depends on the **production system; type of NTFPs extracted; quantity produced; demand for it; prices of it; number of collectors, etc.**

Cont...

In fact, any harvest, small or big, is destructive: it is only the scale!

❖ especially, NTFPs with **high market demand** can cause destruction; e.g. coffee, incense.

what makes NTFPs different from timber and important for conservation strategy?

- (i) Production is less destructive= leaves trees standing;
- (ii) Encourages local forest communities towards careful, sustainable management of the forest;
- (iii) Poverty alleviation = reduces deforestation pressures.

Cont...

- Therefore, NTFPs are important forest goods which are environmentally friendly and help conservation of biodiversity

Typical Examples:

Rattan production in SE Asia:

Rattan is a climbing palm which requires **support and shade**.

Its cultivation **does not need clearing** existing forests.

Cont...
Rattan production.



NTFPs for Livelihood

- **Different versions:** are integral part of rural livelihoods and food security
 - **Specialized strategy:** commercialized NTFPs with high income provision, e.g. coffee
 - **Diversification strategy:** part of portfolio of income sources but still play considerable income with regular involvement
 - **Coping strategy:** only during hard time – as safety net – quick cash or subsistence during difficulties

Cont.

- ❖ **The issue of poverty alleviation through NTFPs is contested:** depends on;
 - the availability/abundance of the products;
 - the market and price situation; and
 - the institutional frameworks (right of access, production technology, value added processing, etc).
- Often in natural state, NTFPs resources are scattered = production costs is high (time and labor) to be significant contributor.
- In most cases, when the NTFPs are of significant contributor to livelihoods, forest conditions are modified for increased production:
 - Natural forest based extraction – gradual modification (Semi-managed system) – AF system – cultivated system.

Cont..

In general: NTFPs Win - Win?

- **Difficult to confirm:**
 - **Extraction can help poverty alleviation but when taken to do so will destroy the forest.**
 - **Achieving both objectives through NTFPs based forest use has limited potential!**

5.2.NTFP Management

- NTFP management should mean an overall responsibility of conserving & developing the resource with sustainable utilization and equitable distribution.
- Several categories of management practices could be distinguished for the production and maintenance of NTFP resources;

I. Maintenance of the resource through controlled utilization and protection

II. Stimulation of the production of required products within existing vegetation

III. Stimulating regeneration of valued species

Cont....

(i) Maintenance of the resource through controlled utilization and protection

- Activities under the practice:

- Only certain sp. are harvested according to stand composition. E.g.: size
- Rotational harvesting regimes are employed
- Using harvesting techniques which do not cause tree mortality.

E.g. Limiting harvest level

- Control of pests and disease. E.g.: sanitary pruning

Cont....

(ii) Stimulation of the production of required products within existing vegetation.

- Activities under this practice:
 - Selecting coppice shoots, rejuvenation pruning,
 - Decrease water/nutrient/ light competition through weeding and thinning non-desirable species
 - Optimization of soil conditions. E.g. mulching to favor desired species

Cont....

(iii) Stimulating regeneration of valued species

- Activities under this practice:
 - Protection of natural regeneration
 - Stimulating of root sprouting
 - Planting of cuttings
 - Transplanting of seedlings
 - Enrichment/ purposeful seeding.

5.2.1 Sustainability of NTFP Management

- Sustainable resource use can be defined as the maintenance of an undiminished flow of benefits from the resource to its users overtime.
- In this context, NTFP management to be called sustainable, it has to be lucrative over time.
 - Yield social improvement for its participants.
 - Does not compromise ecological and agronomic equilibrium.

Cont..

- Sustainability of NTFP extraction is viewed from multiple perspectives:
 - Ecological
 - economic, and
 - Socio-political perspective,

Ecological Sustainability

- The ecological sustainability of NTFP harvest is central to long-term availability of NTFP at broad scale.

And, this can be seen at three levels.

- At the level of individual organism
 - At population level
 - Ecosystem/community level
- * A healthy population with the capacity of replacing what is harvested, is represented by inversed J-shaped curve (in uneven aged forests).

Cont...

- * Steps towards ecological sustainability of NTFP harvest
 - Complete processes of ecologically sustainable NTFP exploitation comprises six basic operations.
 - i. Species/forest type selection
 - ii. Forest inventory
 - iii. Yield study
 - iv. Periodic Regeneration survey
 - v. Harvest assessment
 - vi. Harvest adjustment

Cont...

i. Species selection

- The decision of which plant resources to harvest will be based on economic and social criteria
- Important ecological factors to be considered during species selection include:
 - Life cycle characteristics of the species:
 - ✓ Phonology of flowering, fruiting, pollination and seed dispersal.
 - The type of resource produced: bark, roots, leaf and latex()
 - Its abundance in the forest

Cont....

ii. Forest inventory

- Data regarding structure and density of the NTFP species is gathered through quantitative FOREST INVENTORY.
- The inventory should provide a reasonably precise estimate of the total number of harvestable trees per hectare (i.e., the resource density).
- The inventory should provide data on the current population structure or size-class distribution of adult trees. Collecting these data requires that the diameter (cm DBH) of all stems be measured

cont'd..

iii. Yield study

- This is conducted to estimate the total quantity of resource (yield) produced by trees of varying size.

To measure the yield from all of the individuals in a population,

- 1, a representative sample of plants of differing size is first selected from each forest type. The sample plants should be permanently labeled with paint to facilitate their relocation in the field and to monitor the impact of harvesting.
- 2, The productivity of each sample plant is then carefully measured (Counting fruits is different from counting leaves or measuring stem growth (e.g. for rattan), and latex which drips slowly into a cup is different from crystallized resin.

Cont....

- , Finally, the data collected from each sample tree are plotted to construct a simple scatter plot or yield curve for each forest type showing the relationship between plant size and yield.
- Studies will tell us how much of the desired resource each one of these trees produces.
 - (1) how much the entire forest can produce,
 - (2) what size plants are responsible for the largest percentage of this production, and
 - (3) which forest types provide the highest yields.
- To account for this variability, yield studies should be repeated every few years using the same group of sample plants.

Cont....

iv. Periodic Regeneration survey

- is used to quantify the initial density of seedlings and saplings in the population being exploited, and to monitor the way in which this density fluctuates in response to differing harvest levels.
- Harvesting may kill a large number of adult plants or may remove an excessive number of seeds from the forest.
- So can avoided, by periodically monitoring the density of seedlings and saplings.

Cont....

v. Harvest assessment

- Harvest assessments are an additional type of monitoring activity used to gauge the ecological impact of resource harvest
 - This is visual appraisal of the behavior and condition of adult or harvestable trees
 - It enables to detect problems with reproduction or growth before it becomes serious enough to reduce seedling production

Cont....

The sample plants selected and marked for the yield studies are perfect subjects for these observations. Examples of the type of information to be recorded during these assessments include:

- overall vigor of the plant,
- wounding caused by harvesting,
- trampling of seedlings by collectors,
- evidence of insect pests or fungal pathogens, and
- abundance of fallen flowers and immature fruits under the crown

VI. Harvest adjustment

- Seedling and sapling density records in the original regeneration survey are used as threshold value by which sustainability is measured.
- As long as density remain above the threshold value and no major problems are detected in the harvest assessment, there is high probability that the current level of exploitation can be sustainable.
 - If density of seedlings and saplings is below the threshold level => harvest adjustment is required

How to make Harvest adjustment?

Cont...

- Two methods:
 - i. Regulate the number and size of the plants being exploited
 - ii. Limit the total area from which the resource is harvested (Rotational harvest)

Socio-political Sustainability

- Resources are managed for the benefit of people.
- So, in the management, the livelihood of forest dependent communities should be emphasized.
- **Equitable access to economic values**
 - Transparent system of using property allocation
 - Access to NTFP products to user groups
 - Employment opportunity for local communities
- **Equitable access to economic decision making**

Cont....

❖ **Local communities should be empowered**

- Local communities should be allowed to control development programs based on their own priority
- Community organizations should be able to deal with the diverse interests of all the different NTFP users and stakeholders
 - There should be equitable bargaining power among individuals or groups/ stakeholders
 - Local knowledge should be respected and used in NTFP resource management.
 - Sites of special social, cultural, spiritual, and historical significance should be maintained

Economic Sustainability

Economic sustainability of NTFP extraction is measured in terms of :

- **Efficiency** - in terms of resource utilization
- **Economic feasibility** - the soundness / profitability of NTFP extraction
- ❖ Efficient exploitation and processing
 - High use rate of local processing capacity
 - Low waste ratios in processing
 - Product diversification

Cont.

❖Economic feasibility

- Natural resource availability (quantity and quality) and Accessibility of the resource for use
- Labour and skill availability for utilization of the resource
- Availability of capital, market,
- competitiveness

6. Value Chains

- Agroforestry product value chain concerns the activities involved in bringing a tree, crop and livestock products through **processing and production, to delivery to final consumers.**
- It includes activities such **as harvesting, cleaning, transport, design, processing, production, transformation, packaging, marketing, distribution and support services.**
- Such activities generally add value to a product as it moves along the chain.
- A chain can range from the local to the global level.

Activities may be implemented by various individuals or organizations, termed '**actors**', such as **harvesters, processors, traders, retailers and service providers.**

Cont...

- The relations between actors and control of chains is known as **chain governance** (Gereffi and Humphrey 2005; Helmsing and Vellema 2011).
- Chains and products embody multiple relations of **value – often explicitly economic but also social, cultural and environmental**.
- A value chain entails the **addition of value** as the product progresses from input supply to production to consumption.

Value chain ...

There are different type of chains

- All are composed of companies (or individuals) that interact to supply goods and services.
- It varyingly referred to as production chains, value chains, marketing chains, supply chains, or distribution chains.
- vary mainly in their focus, in the activity that is emphasized, and in the way in which they have been applied.
- Most common of them are value chain and supply chain.

Cont....

- value chain is defined as: 'the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use'.
- The primary focus of supply chains is on cost and efficiencies in supply, while value chains focus more on value creation, innovation, product development, and marketing.
- the value chain focus is essentially about value.
- **They are supported by a range of technical, business and financial service providers called supporting actors.**

Cont...

- There's a temptation to use "value chain" and "supply chain" interchangeably,
- but there is a difference in the concepts that is significant.
- **The supply chain model - which came first - focuses on activities that get raw materials and subassemblies into a manufacturing operation smoothly and economically.**
- A supply chain is simply a transfer of a commodity from one stakeholder to another in a chained manner.
- The value-chain notion has a different focus and a larger scope.
- The value chain is the value addition at different stages of transfer.

cont...

- In different stages of value chain, different stakeholders add value to the product to increase the end product value.
- In other words, a value-chain analysis looks at every step **from raw materials** to **the eventual end-user** – right down to disposing of the packaging after use.
- The goal is to **deliver maximum value** to the end user for the least possible total cost.
- Value chains are also the medium through which:
 - **Product** moves from producers via several channels to consumers
 - **Finance** (revenues, credit, and working capital) moves from consumers to producers;
 - **Technologies** are disseminated among producers, traders, processors and transporters;
 - **Information** on customer demand preferences are transmitted from consumers to producers and processors and other service providers.

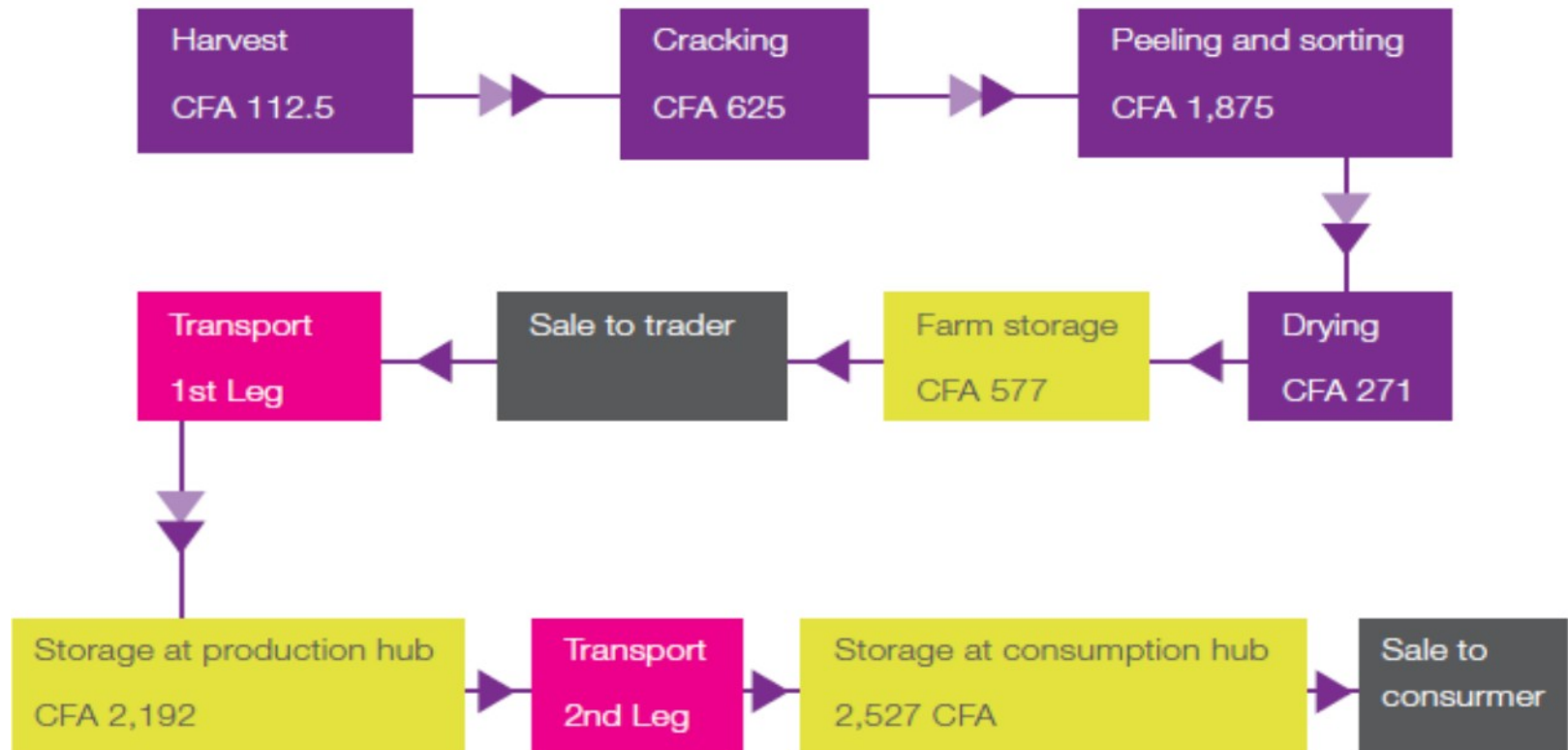
Value chain map and function

- **Mapping a chain** means creating a visual representation of the connections between businesses in value chains as well as other market players.
- It illustrates core transactions and show that connections have varying importance;
- help identify bottlenecks and leverage points.
- shows how core transactions in value chains are connected with the market players.

Mapping done to identify:

- **Actors** (key actors and supporting organizations)
- **Relationships** and **interactions**
- **Values** (distribution of)
- geographic **flows**
- Different **marketing channels**

Example of a value chain core processes (Coca nut)



Value Chain stakeholders

- **Value chain actors:** The chain of actors who directly deal with the products, i.e. produce, process, trade and own them.
- **Value chain supporters:** The services provided by various actors who never directly deal with the product, but whose services add value to the product.
- **Value chain influencers/enablers:** The regulatory framework, policies,

Value chain governance

- Governance refers to who is controlling what is happening in the value chain including the rules that determine the behavior of actors
- Three key determinants of value chain governance patterns:
 - **complexity of transactions**; The complexity of information and knowledge transfer required to sustain a particular transaction, particularly with respect to product and process specifications
 - **codifiability of information**: the extent to which this information and knowledge can be codified and, therefore, transmitted efficiently and without transaction-specific investment between the parties to the transaction
 - and **capability of suppliers**: the capabilities of actual and potential suppliers in relation to the requirements of the transaction

Cont..

Governance analysis may encompass/include:

- Which actors and institutions **coordinate** the chain
- What is the **impact** of government/semi-government **regulations** on the functioning of the value chain
- Is there a **role for NGOs** to establish cooperation of small holders or other links in the value chain
- Is the value chain **vertically integrated?** or **cut up** in a number of segments
- Is there **adequate coordination** of horizontal relationships

Typology of VC Governance

Five major types of vc governance:

Market

- Transactions are **market co-ordinated**
- The essential point is that **costs of switching to a new partner are low for both parties**
- **Low level of information asymmetry**/less information differences/

Modular

- Typically, suppliers manufacture products according to the detailed **instructions** of the purchaser, but maintain full responsibility.
 - e.g. for the process technology employed
- Modular value chains offer suppliers the possibility of a stronger integration from which positive impacts as reliability, transfer of know how and others can be expected without loosing the own independence

Cont....

Relational VC

- *When product specifications cannot be codified, **transactions are complex**, and **supplier capabilities are high**, relational value chain governance can be expected.*
- *complex interactions exist between buyers and sellers, which often creates mutual dependence and high levels of asset specificity.*
- This may be managed through reputation, or family and ethnic ties.
- the role of spatial proximity in supporting relational value chain linkages is paramount.
- but trust and reputation might well function in spatially dispersed networks where relationships are built-up over time or are based on dispersed family and social groups.

Cont....

Captive VC

- When the ability to codify – in the form of detailed instructions – and the complexity of product specifications are both high but supplier capabilities are low, then value chain governance will tend toward the captive type.
- small suppliers are transaction ally dependent on much larger buyers.
- Suppliers face significant switching costs and are, therefore, 'captive'.
- Such networks are frequently characterized by a high degree of monitoring and control by lead firms.

Cont..

Hierarchical VC

- This governance form is characterized by vertical integration.
- The dominant form of governance is managerial control, flowing from managers to subordinates, or from headquarters to subsidiaries and affiliates.
- Product specifications cannot be codified, products are complex, and highly competent suppliers cannot be found.
- It lead firms will be forced to develop and manufacture products in-house.

Value chain Governance ...

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	Low
Modular	High	High	High	
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	High

Why interest for VC Analysis

- A comprehensive understanding of the operation of commodity markets requires an understanding of the operation of the different stages through which a product and its associated value additions pass on from **production to consumption or end use**
- A comprehensive understanding of the coordination of the value chain requires ,
- a **careful assessment of consumer demand characteristics and the organizational and institutional arrangements** that are in place to meet these demands.

Value chain upgrading

- It Can be achieved by improving the product quality, efficiency of production or better market and non-market network
- Several strategies to value chain upgrading

Horizontal coordination; is the process of greater **intra-nodal organization**, often in the production and processing nodes, in some form of collective structure.

- is the process of firms (which can be as small as individual actors) collaborating within a functional node (be it input supplies, production, processing, trading or retailing) to achieve a strategic balance between competition and collaboration.
- The aim is to collaborate in order to compete more effectively.

Cont....

- Competition drives innovation and upgrading, while cooperation helps firms to achieve economies of scale and overcome common constraints to pursue opportunities
- is especially important for poor people in rural areas because coordination with others allows producers to achieve economies of scale in supplies and to reduce transaction costs.
- is the first step in a sequence of interventions that ultimately result in access to the market, and is a prerequisite for other forms of upgrading.
- Critical to the success of horizontal coordination strategies are the entry rules to join the group and the quality of management of the group structure.
- EG. Coffee farmers' associations beekeepers' associations

Table shows 2.Horizontal upgrading

Status and purpose of horizontal alliance	Scale	Example
Informal, function	Household to international	Fishing crews; multiple-household farms; peer-to-peer- learning arrangements
Formal functional	Micro to national	Producers' & traders' associations; microcredit schemes; community based organizations
Formal,regulatory & advocacy/promotion	Regional (sub-national) to global	Industry associations; business chambers
Formal, economic (share company)	Local to national	Cooperation union (primary association & apex); business groups with centralized service functions

cont....

Vertical coordination; is the process of strengthening relationships between functional nodes of the value chain, involving the shift away from one-off spot transactions toward developing longer-term business connections.

- It is an acknowledgement that there is value in longer-term associations beyond simply establishing the price for output of a particular quality.
- Developing these relationships can be **a slow and difficult process** because it requires, above all else, trust-building among actors.

Cont....

- includes both the functional upgrading-based process of vertical integration and the process of forming and strengthening relationships between nodes in a non-integrated value chain.
- the benefits of vertical coordination can include
- increased input and output market stability and reliability.
- diversification into additional channels and reduced vulnerability, access to imbedded services, risk transfer
- cost reduction, quality assurance and reputational and marketing gains for buyers.

Functional upgrading means changing the mix of activities executed by actors in the value chain by adding or deleting activities to the 'repertoire' of individual firms.

- The process of a firm expanding the number of value chain activities it performs
- is known as vertical integration, a specialized form of vertical coordination
- actors or firms occupy a superior position in the supply chain by moving forwards, or 'downstream', along it to capture greater value.
- The main value chain-level benefits of functional upgrading relate to increased efficiency, for example through reduced transaction costs, increased share of final product value, risk

Cont..

Process upgrading-working smarter

- achieving a more efficient transformation of inputs into outputs through a reorganization of productive activities'
- Low productivity and poor product quality are key barriers to the participation of the poor in markets.

Product upgrading specifically refers to a process of producing more sophisticated product lines; introducing new product or improving old products

Inter chain upgrading: applying the competence acquired in a particular function of a chain to a new sector or new chain: moving into a new value

Purposes of VCA

- Identification of leverage points to improve chain performance
- Analysis of agriculture-industry linkages
- Analysis of income distribution
- Analysis of employment issues
- Analysis of economic and social impacts of interventions
- Analysis of environmental impact of interventions
- Guide collective action for marketing
- Guide research priority setting
- Conduct policy inventory and analysis

Value/benefit in the chain

- Amount a good or service is worth of in the market
- Three types of value
 - **Form value** - associated with the change of the form of a raw material (production, processing)
 - **Time value** - related with availing at another period of time produce produced at a period of time (storage) eg. Harvesting/hungry period
 - **Space value** - related with availing at another location product produced in

Example: Costs and margins of actors involved in a market channel selling sheep

●	Producers	Brokers	Collectors	Transporter/ traders	Hotels
Selling price	750	810	820	870	1280
Marketing cost	-	0	16	39	95
Marketing margin	-	60	70	50	410
Net margin	-	60	54	11	315
Producer's share of final price (%)	41	-	-	-	-

Value chain data for intervention

- Value chain development requires data and robust analysis of the data
- Gives information about:
 - The core processes in the VC
 - The main actors in the process
 - Capability and relation of actors
 - The product, information, technology flows,
 - Volume of flow
 - Identification of leverage points for VC development
 - Costs and margins at different levels
 - Constraints and opportunities at the different levels

Issues to consider for value chain Intervention

Assist the entry, participation and upgrading of the rural poor in value chains.

1. Clarity on the purpose for the intervention:

Whether the primary aim of an intervention is to **reduce poverty or to stimulate growth** in the local economy or both.

2. Selecting an appropriate value chain: The **choice** of value chain has important implications for the **barriers to entry** for the farmers and for the sustainability of the initiative.

3. Research and planning for intervention: requires robust evidence-based research of the current market system and a clear identification of **bottlenecks and strategies/interventions**.

4. Defining most important intervention: **prioritize** interventions proposed for value chain development

Cont..

- 5. Identifying the key benefits to poor producers to participate gainfully and sustainably:** identify how and from where smallholder **farmers gain** from VC.
- 6. Reducing barriers to entry:** All social and economic **barriers to entry** in to value chain needs to be thoroughly studied and eliminated
- 7. Avoiding **obsessing about the production node** in agricultural value chains:** Poor people engage with value chains at all nodes as producers, intermediaries, workers and consumers.

It is not necessarily the case that the largest pro-poor impact should center on the production node.
- 8. Providing the enabling environment:** it is the duty of the local government OR marketing officers to create an enabling environment for poor farmer participation in the value chain at **various nodes**.

Marketing and strategies for AFP

- Marketing is fundamentally about communicating information to increase demand for a product or service
- AF products are usually **perishable**; therefore, a failure to sell on time results in wasted harvest.
- All wasted harvest represents a cost of land, water, labor, storage.
- Agricultural **prices can be quite variable**, impacted by changes in period of sale, weather and harvests in other place.
- Efficient marketing infrastructure such as wholesale, retail and assembly markets and storage facilities is essential to minimize post-harvest losses and reduce health risks.
- Enabling marketing strategy and policy
- Strategies may be designed on product, pricing, distribution, promotion etc.

Cont..

Product strategy

- Selling a product requires **the producer to understand the values that a buyer attaches to the product.**
- is the product already established in the market or not?
 - more marketing information exist for established products
- is it available throughout the year or only during a certain season?
 - In what quantities is it produced in the area?
 - What are the factors that determine its quality as perceived by customers?
 - are these factors in producer's control, or not?

Cont.

Pricing Strategy

Pricing to the market

- What others are charging for the same type of products
- Power to set prices (differentiation, reputation, promotion)
- Demand sensitivity to price changes

Pricing to your costs

- Cover expenses
- Make a profit

Cont.

Distribution strategy

AFPs are generally high volume/to-price ratio, increase cost of distribution/transportation

Getting the products to the buyer

- **Direct marketing**
 - Outlets: farms, farmers markets, CSA, Internet
- Higher risk
- **Intermediary distribution**
- Intermediaries, or *middlemen* can serve important roles that can either help or hurt small-scale producers
- they could be wholesalers, distributors, cooperatives, retailers
- Provide constant dependable supply
- Maintain product integrity along the value chain
- Reduced risk
- Also essential for centralizing supply among dispersed producers and helping to absorb risk in markets

Promotion involves advertising or other ways of raising purchasers' awareness of the product.

- Key questions in promotion for a target market include:
- Why would consumers buy the product instead of a competitor's, or a substitute?
- How will purchasers learn of the product?
- What are the costs and expected effectiveness of advertising options for reaching the target market?
- Should any labelling or brand name be used to identify the product?
- In rural markets, word-of-mouth recommendation can be the most effective promotion.

Communication;

- Message: freshness, local, sustainably produced, healthy
- Tools: adds, flyers, press release, tasting samples

Constraints in VC Development

<i>Barriers</i>	<i>Effect</i>
1. Quality standards in developed countries like the EU limit access to these markets	1. Satisfying these requirements makes export more expensive
2. No skilled worker available locally	2. Low level of technology and no innovation in the chain
3. No access to credit and other resources	3. No possibility to finance the necessary investments
4. Too much local regulation or no appropriate governance structure	4. Too much paperwork is necessary, increasing the cost of production
5. Lack of infrastructure	5. High cost of transportation

Value Addition

- Value addition to a product or service leads to higher financial return with a goal of increased return relative to cost incurred
- Increasing revenue and profit
- Produce new produce and open new market opportunity
- Transform an ordinary/waste product into extraordinary/ valuable product
- Involves series of activities from species selection to processing, marketing, packaging, certification etc...
- Knowledge, innovation, entrepreneurship play important role for success

Cont.

Discussion point

- Mention different examples from your experience and amount of investment for value addition and return to investment



Benefits of Value addition

Producer

- Higher revenue, higher profit margin
- Differentiate products in market place
- Take advantage of local brand/name e.g. 'Beleche' Chat
- Diversify market/customer base
- Increase utilization of harvest
- Greater power to set prices
- Make use of off-season market
- Develop passion and self-satisfaction for producing successful value added

Cont..

Consumer and society

- Processed, prepared, ready to consume products
- Superior quality and service
- Support local producers
- Support local economy
- Fresher, more flavored & nutritious
- Support a cause e.g. locally grown/propoor
- Prestige of special product e.g. forest honey/coffee
- Knowledge about the food
- A closer relationship with producers and the food

Value adding methods/typology

Production

- Crop/species selection
- Variety selection
- Management type/intensity
- Harvest techniques
- Post-harvest care/handling

Processing

- Convert to valuable product
- Preserve to maintain quality
- Develop new product
- Preserve valuable qualities e.g purity/freshness
- Improve the processing machine/tool

Cont..

Marketing

- Packaging
- Labeling
- Branding
- Certification

Support Service

- Information/knowledge
- Guarantee for damage/ liability
- Interaction/networking
- Delivery/transportation

Cont...

Species selection

- Environmental suitability
- Presence of unfilled market
- Time availability to harvest the species
- Value added potential among range of crops
- Profitability
- Labor and capacity
- Personal passion

Species selection



Cont....

Processing

- Is the backbone of value addition; because:
- It creates unique product that are differentiated in the market place
- Processed products fetch a higher price
- Skill and equipment may be needed...
training and experience
- Understanding the law of the country about processing

Value Added



Post harvest

- Post harvest practice prepare crops for sale, processing or storage
- They improve or reduce the value of the crop
- Thus is essential part of value added practice
- Each crop may have its own unique postharvest handling requirements and needs to be understood and implemented
- Avoiding mechanical damage, high temperature exposure and microbial/disease contamination
- Post harvest treatments may include all practices from harvest to consumer... though mainly focused on those immediately after harvest

Cont.

Post harvest care includes:

- During transport/handling- minimize bruising or other injury, maintain temperature and ventilation
- Cleaning including washing brushing, air blowing
- Sorting blemished or rotting produce and group into various size, color and maturity/ripening
- Packaging or packing to reduce damage
- Controlling insects and pests
- Maintain acceptable temperature and humidity depending on the character of the product

Customer safety

Depending on the nature of the product, emphasis on safety of customers is considered as value addition

- Compliance with sanitary and phytosanitary requirements
 - Fulfill importers required quality
 - Pest damage/risk assessment and prevention
 - Design protective treatments, depending on the product
- Design approaches to safety and security issues
 - The ability to ensure a reliable supply of quality and safe produce is one of the pillars of the success
 - Respond reactively and proactively, to the demands of and laws of importing countries
 - Quarantine of products that may not pass stringent quality and safety standards of importers
 - Coordinated public and private institutional efforts to ensure compliance

Innovation and agricultural innovation

- Innovation is defined as the intentional discontinuous change in inputs, processes or outputs of an enterprise
- new to the firm/farm, new to the market/new to the world.

- It has the following components:

product innovation - the introduction of a new good or a new quality of a good;

process innovation: the introduction of a new method of production, including a new way of handling a commodity commercially.

market innovation: the opening of a new market.

input innovation: the conquest of a new source of supply of raw material or intermediate input.

organizational innovation: the carrying out of a new organization of industry .

Cont...

- An invention becomes an innovation when it is put in use
- To be able to turn an invention into an innovation, different types of knowledge, capabilities, skills and resources are needed
- Innovation = technical + Organizational + commercial success
- Innovation is not only about global novelty, but often about local creative imitation.
- Innovation can involve radical changes, but more usually many small improvements and a continuous process of upgrading
- Innovation can be triggered by the market (most often), policy changes (sometimes) and research (rarely) (Push/pull factors).

System of innovation

- innovation is systemic - Implies that Innovation is embedded in a system of institutions and actors that can support/run them.
- All important economic, social, political, organizational, and other factors that influence the development, **diffusion, and use of innovations**.
- All the actors and their interactions involved in the production and **use of knowledge**, and the institutional and policy context that shapes the processes of knowledge access, sharing and learning.
- Edquist(2005) equates it with the determinants of innovation process (institutions, actors, interactions and functions).
- SI analyzed at different scale and sectors.

Cont....

The main advantages of a sectorial system view are a better understanding of:

- the structure and boundaries of sectors;
- agents and their interaction; the learning and innovation processes specific to a sector;
- the types of sectorial transformations;
- and the factors at the base of the differential performance of firms and countries in a sector.

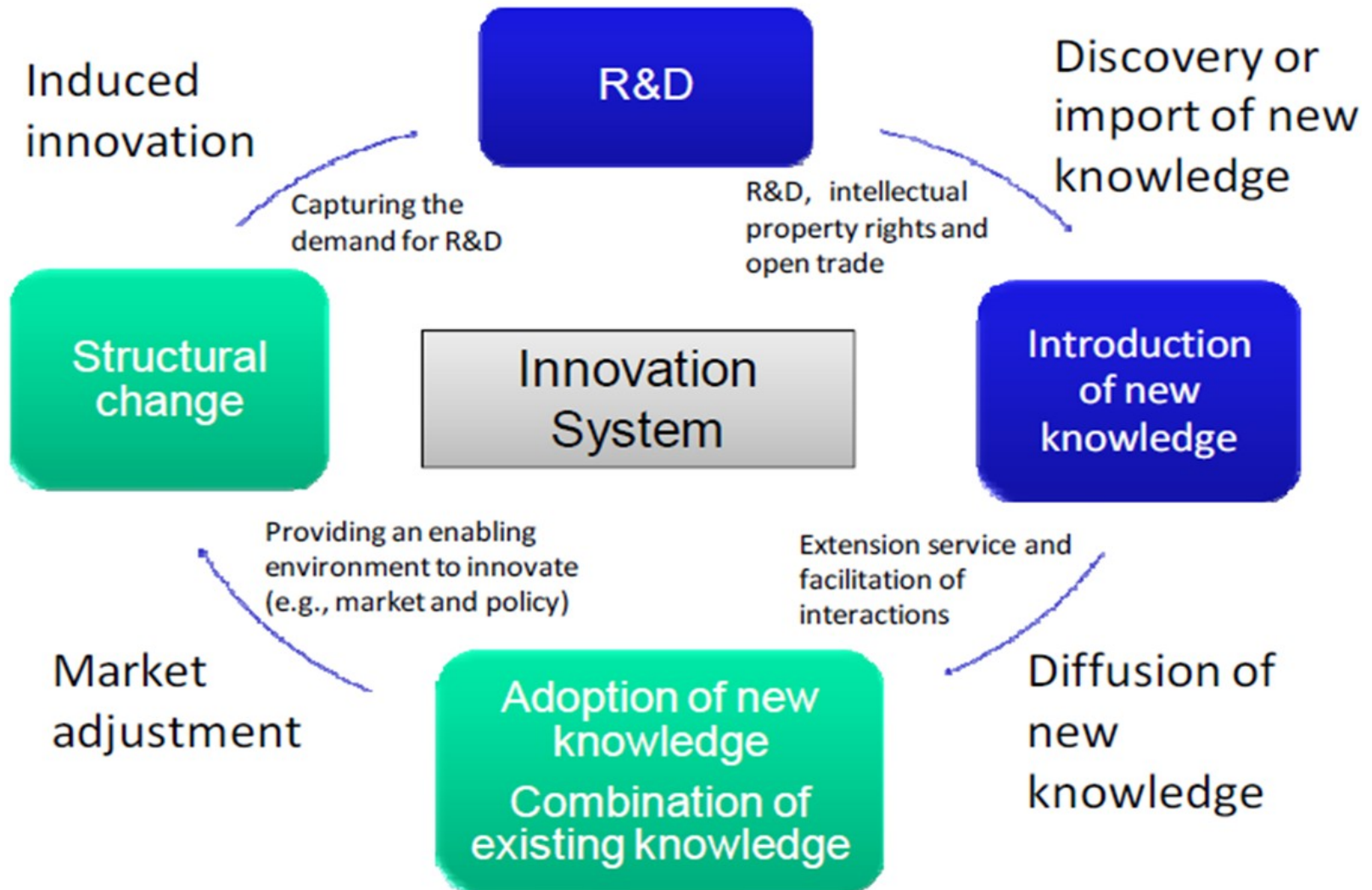
Sectorial innovation system

- The major issues are:
 - knowledge and technology;
 - actors and networks
 - organizations
 - and institutions which have **relevance specific** to the sector

Agricultural innovation system

- An AIS approach looks at the **multiple conditions and relationships that promote innovation** in agriculture.
- offer a more flexible means of dealing with the varied conditions and contexts in which innovation must occur. It considers the diverse actors involved, their potential interactions, the role of informal practices in promoting innovation, and the agricultural policy context(SI).
- it integrates
 - (I) the more traditional interventions (support for **research, extension, and education**, extension to farmers) and
 - (II) complementary interventions like providing the **professional skills, incentives, and resources to develop partnerships** and businesses; improving knowledge flows; and ensuring that the conditions that enable actors to innovate are in place.

An illustration of the innovation dynamics in agriculture



Identification of appropriate Innovation for AF

Innovation need could be generic or specific, but has to be important to

- Increased productivity
- Improving the value adding technology
- Horizontal coordination to reduce inefficiency and costs
- Compliance with sanitary, safety and other quality requirements for competitive market
- Market and export competitiveness expansion through innovation
- Creating and coordination of linkages among important actors
- Understanding and responding to the coevolution/dynamics of need/market and appropriate technology

How best it be designed

- Bottom-up, farmer driven innovation
- Community -based / village-based
- Value farmer knowledge, knowledge of place, traditional ecological knowledge.
 - But be cautious about exaggerated view of local knowledge
 - Gather knowledge from all actors
- Social action group/network
- Interdisciplinary- health, education, agriculture not separate functions, part of each other.
- Holistic, participatory
- Local community empowered

Understanding (changing) context for agribusiness

- Markets, not production drive most agricultural development.
- The economic environment of agriculture has become more **dynamic, interconnected and evolutionary** – largely due **to globalization, also urbanization**.
- Rate of change has increased, with a need for more rapid responses
 - **competition, trade rules, technological paradigms, climate, pest and diseases**
- The role of the private sector in generating and using knowledge has grown
- ICT has radically changed the accessibility of knowledge and information
 - E.g enable Ethiopian crafters access Vietnamese craft work
- The knowledge structure of agriculture is changing – eroding the primacy of public agricultural R&D and R&D organizations.
- Design, packaging, post-harvest, private advisory services.
Less elite more consultative

Responding to challenges

- Analysis of trends, changes & factors affecting transformation of agri-food systems;
- Characterization agro-industries and value chains;
- Analysis & benchmarking to identify strategies for agro-industry & value chain development; and
- Development of information & knowledge management systems.
- Appraise market & agribusiness opportunities & develop sound methods for prioritizing agro-industries & value chains;
- Facilitate innovative arrangements **linking smallholder farmers with commercial farmers, exporters or agro-processing firms** in long-term relationships
- Identify innovative micro-financing products that facilitate the participation of small farmers in agribusiness ventures;

Cont..

- Design & implement initiatives that improve entrepreneurial capacities of smallholder farmers.
- Design small agro-enterprises to participate in value chains for high-value products, including branded and certified products.
- Identify & use innovative mechanisms to link public funding with private sector resources.

Enabling Policies, Institutions & Services:

- Strategies for improving AF policies, legal and regulatory frameworks, institutions & services.
- Incorporation of AF strategies and actions into country-level program frameworks & strategic plans for agricultural development.

Cont.

- Reinforce communication & cooperation with firms, foundations and NGOs active in AF development.
- Reinforce compliance & certification systems for food safety standards and industry quality requirements.
- Reinforce market information services & financial institutions & services for market-oriented farmers and agro-enterprises; and
- Provide basic infrastructure to improve market access and reduce business costs.

Cont.

