AGRICULTURE
FORM FOUR
STUDYNOTES

CROP PRODUCTION

THEME 1.0: CROP PRODUCTION

Perennial field crop's production

Coffee production

Scientific name:

i. Coffee Arabica

ii. Coffee Arabica

Family name: Rubiaceae

Origin: The plant originated from Ethiopia highlands and was introduced in East Africa towards the end of 19th Century by French and Roman Catholic Missionaries.

Plant Characteristics

- Is a perennial plant with an economic life of more than 70 years.
- Beans of coffee (cherries) found contain 1-1.5% caffeine (as a stimulant beverage).

- The plant produces two types of branches vertical and horizontal branches mainly.
- The plant is self pollinated.
- The fruit is commonly referred to as a BERRY with two beans (cherries).
- When the berry is ripe the outer skin (exocarp) endosis a shing MUCILAGE (mesocarp) which in turn encloses a rough inner membrane (endocarp), this is commonly known as PATCHMENT enclosing 2 beans. A very thin TESTA known as SILVER SKIN (pulp) add here to each of the beans.

Economic Importance

- The dried beans are roasted, ground and brewed to make a stimulant beverage.
- The coffee pulp and parchment can be used as a manure and mulch once fermented (decay), decomposed.
- The pulp can be fed to livestock and the parchment can be used as deep litter.
- The pulp can also be used for the production of methane gas.

Distribution in Tanzania

i. Kilimanjaro, Arusha, Mbeya - Arabica

ii. Ruvuma, Kagera, Kigoma, Bukoba -Robusta

ECOLOGICAL REQUIREMENT

- Altitude: 1200m-1800m a.s.l.
- Temperature: Optimum temperature is 15c-25c

- High temperatures bring fast and soft growth with extended internodes.
- Low temperatures the inter nodes shorten and the tree becomes bushy.

o Rainfall: 760mm-2500mm p.a.-Robusta

1500mm-2300mm p.a-Arabica

o Soils: Well drained, deep fertile soil with a pH of 5.2-6.2

NB:

i. Problems associated with low altitude

a. Tendency of continuous production of small flower.

b. stunted growth

c. Crinkling of leaves

ii. Problems associated with low altitude

a. The climate favors pest like Berry borers and diseases like rust

b. Multiple stem pruning cycle becomes too short

c. Coffee quality is usually low.

PROPAGATION

Seed selection

o Seeds must be selected from high yielding mothers which are free from pests and diseases.

o Harvest mature ripe berries (red in colour)

o Pulp and ferment, all flouting seeds must be removed.

- Dry seeds under shade to a moisture content of 18%-14%

Nursery site

- Should be near water source.
- Should be sheltered to prevent wind.
- Should be at a gentle slope.
- Should have deep and fertile soil.
- All weeds, stones must be removed.

Nursery sowing

- Prepare seedbeds of the 1.2m and 10.8m long leaving a path of 0.9m between them.
- Pre-germinate the seeds at later saw them in the seedbeds at a spacing of 15cmx15cm or 20cmx20cm and 2.5cm deep.
- Shade should be provided as well as water should be done.

NB:

- Seeds should be planted with flat side down ward.
- Seedlings are ready for transplanting 1-11/2 years when they attain 30cm tall.

Transplanting

- Field preparation should start 6 months prior rain season.

- All plant/ tree roots must be removed to avoid the development of Armillaria Mellea fungus which may cause Armillaria root diseases to the crop.
- 3 months to the rain season, transplanting holes have to be prepared.
- Prepare holes of the size 60cmx60cm at a spacing of 2.7mx2.7m (for Arabic) OR 3.3mX3.3m (for Robusta). This is used if shade trees are not used.
- If shade trees are used the spacing in increased to 14mx144m (Arabica) and 22mx22m (Robusta).
- 2-3 weeks before transplanting 1debe of top soil and 1debe of farm yard manure or compost is mixed and filled in the holes.
- A peg is put at the centre of the hole to mark or place where the seedling will be inserted.
- During transplanting roots (especially tap root) must not be bent.
- Mulching should be applied around the stem but not touching the stem.

Advantages of shade trees in coffee field

- Reduces evapotranspiration.
- Most of the shade used is leguminous hence they help to supply Nitrogen to the plant.
- It modifies climate.
- It reduces soil erosion.
- Before the foliage decomposes it acts as mulch and after decomposition it acts as manure.
- Reduces wind effects.

Common shade trees are:

- Gravellea robusta
- Albizia spp
- Cordia Abyssinia

FIELD MANAGEMENT

i. Weeding

a) Common weeds found in common fields are: Couch grass, star grass and Kikuyu grass.

b) Weeding can either be done by cultural method e.g. mulching cultivation using simple tools or slashing.

c) Chemical control involve use of herbicides e.g. paraquat, smazing atrazine, dalopon etc.

ii. Fertilizer application

a) On soil with pH below 5, CAN (Calcium Ammonium Nitrate) should be applied.

b) Soils with pH5-6.5, CAN and NPK should be applied on alternative years.

c) On soil with pH greater than 6.5, SA (Sulphate of Ammonium) or Urea can be applied/ used.

d) The rate of application depends on the soil nutrient level but ranges from 90kg N/ hact -255kgN/ hact

iii. Pruning

This is the act of removing dead branches; pest and diseases attacked branches as well as old branches.

Purpose:

- Improve light penetration.
- Improve spacing
- Discourage pest and fungal diseases.
- Facilitate application of pesticides.
- Facilitate easy harvesting.
- Facilitate formation of high quality berries.
- Facilitate vigorous growth.

Types of pruning

a) Single stem pruning: This involves retaining the original stem and keeping a height of 1.5-1.8m tall.

b) Multiple stem pruning: This involves retaining 2-4 upright stem.

Stages of pruning

a) Formative stage: This involves establishment of the main work of the tree on which every system of trimming (pruning) will be done.

b) Actual pruning stage: This involves routine encouragement of vigorous growth of the production of a healthy tree and heavy cropping.

Pruning

Arabica coffee should be grown as a single stem system. Pruning is required to:

- supply good healthy wood for the next season's crop;
- maintain the correct balance between leaf area and crop (Figure 27);
- prevent overbearing and dieback;
- reduce biennial bearing;
- Maintain good tree shape.

Desuckering

Year 1

- Desucker to maintain a single stem system and avoid competition from suckers (Figure 28).
- Remove 'fly crop' fruit (early fruit which compete with strong plant/root development) as they appear.

Year 2

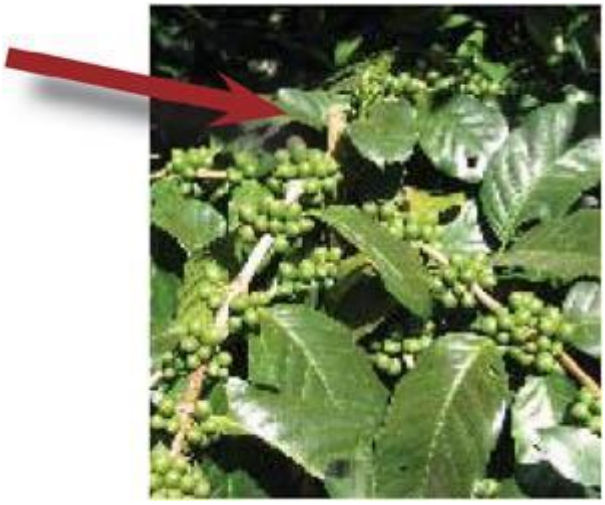
- Desucker to remove drooping primary branches that touch the ground. Cut back to nearest secondary branch.
- Remove secondary branches within 8 inches (20 cm) of the main stem. Remove all fruit as they appear (fly crop).

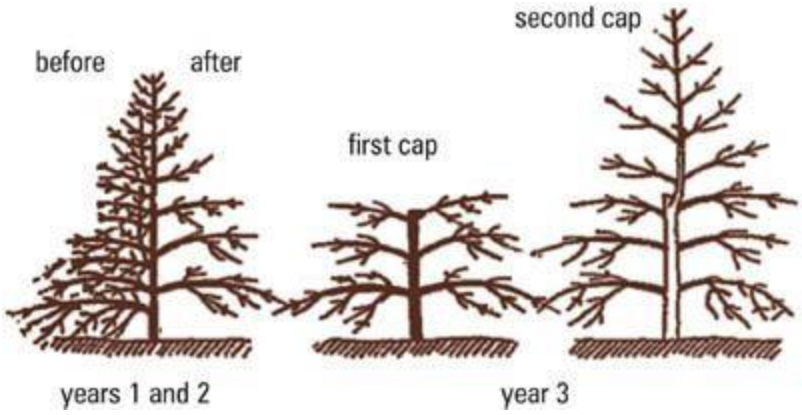
Year 3

- Trees should be allowed to crop in the third year.
- Cap the main stem by cutting above a side primary shoot at about 5 ft (1.6 m) from soil level.
- Desucker to remove drooping primary branches touching the ground. Cut back to nearest secondary branch.

- Remove secondary branches within 8 inches (20 cm) of the main stem.
- Maintain a maximum number of well-spaced secondary branches on each primary branch.
- Remove all dead, weak and spindly pest or disease damaged branches.

As plants grow, they can become too crowded and suffer loss of production. Alternate trees can be stumped by cutting off at knee height - about 20 inches (50 cm) from soil level. When these trees are producing again after two years, stump the remaining trees (see notes on stumping).





General pruning and desuckering of tree over years 1 and 2. Capping during year 3. Newly capped tree photo (above)

Rejuvenation (Change of cropping cycle)

A regular rejuvenation pruning is needed (normally at six to seven years depending on tree vigor and yield pattern), to maintain a source of new fruiting wood. Unless trees are renewed, yield will decline over the following years.

Two rejuvenation methods are used:

- Side pruning
- Full stumping

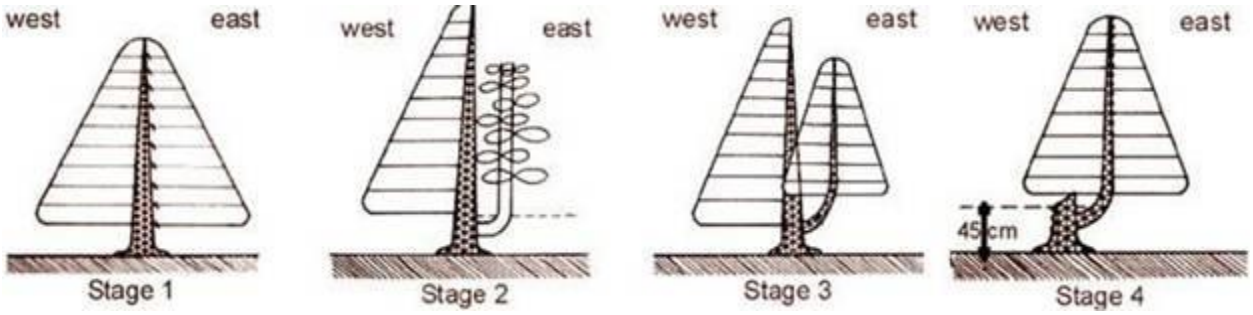
Side pruning

This involves removing one side of the tree, training a new sucker and then removing the other side of tree two years later. This method is recommended for all growers, as only 50% of the crop is lost for the two-year period.

Two years before stumping, remove all branches on the eastern side of tree after harvesting. Select a new sucker approximately 12 to 18 inches (30 to 45 cm) from the soil level, and train the shoot by thinning as described for a new planting (Stages 1 and 2) until bearing a crop (Stage 3).

Two years later, stump the older stem above the new stem. Cut at a 45° angle - do not cut straight (Stage 4).

A coffee tree after being side pruned



The four stages in side pruning a coffee tree

Diagram of full stumping procedure. Choose the strongest shoot and remove the rest; note the 45° cut angle. Photograph of a stumped tree after re-growth (left)

- Remove all young suckers from the main stem.
- Remove all secondary branches around primary braches within 15cm, from the main stem.
- Remove all dead, diseased, pest attacked and non-bearing branches.
  - The final result should be 170cm and wide enough to allow light penetration.

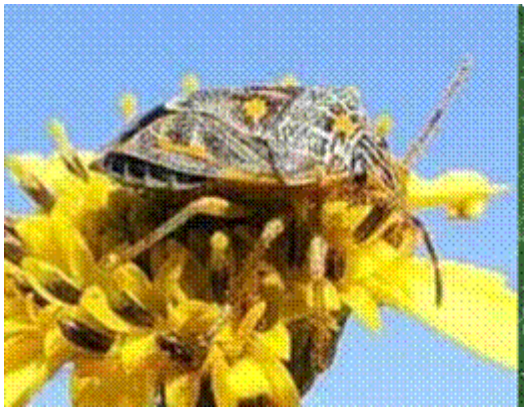
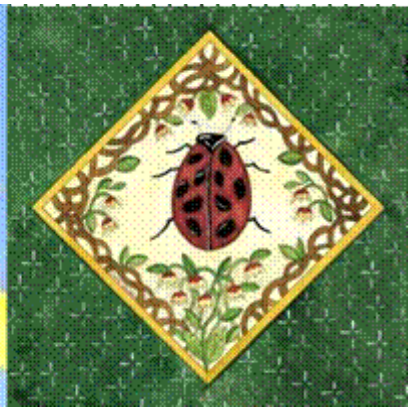
iv. PEST AND DISEASE CONTROL

a) Pests

i. Leaf1 minor: Leucopters spp

Damage: The larva bone into the leaves and feed on the palisade tissues. Brown blotches appear on the leaves.

ii. Antestia bug: The suck the berries causing longitudinal/ zebra stripes and defoliation of buds.

- Other pests include
  - Berry moth
  - Meanly bugs All are sucking insects
  - White scales
  - Thrips

General control: Timely spraying of insecticides e.g. Dursban, Dictofos, Dieldrin etc at a rate of 1litre/ hact.

b) Diseases

i. Coffee berry disease

Cause: Fungus known as Collelotrichum coffeanum

Symptoms:

- The fungus causes the formation of necrotic lesion which turns to brownish rings on leaves.
- On fruits they become blackish, skrikelled and later drops.
- The fungus is spread by rain drops or wind.

Control:

Cultural methods:

- Pruning the affected branches to lower the humidity.
- Remove fruits resulting from season flowering.
- Proper supply of nutrients to plants to increase resistance to the disease.

Chemical methods:

Use of fungicides e.g. Cobox 500WP, Sandox 500WP, Nodox 500WP, Perenox, Bravo.

ii. Coffee leaf rust

Cause: Fungus known as Hemilleria Vastatrix

Symptoms: Yellowish pustules on the leaf causing defoliation.

Control:

- Cultural control
- Chemical use of fungicide e.g. Bravo

Other Diseases:

Wilting (die back)- Fusanium stiboides

Armillaria root rot- Armillaria melea

v. HARVESTING

- Through picking
- Done by hand when cherry is uniform ripe, over ripe, berries (dark) may be difficult to pulp.
- Unripe berries (green) may not have enough mucilage for effective pulping.
- Berries of mixed ripeness cause un even fermentation.
- Yellow berries produce poor quality. Process after picking

Two methods

a) Dry method

b) Wet methods

Dry methods (Buni)

Can be done in two ways

i. The berries can be left to dry out in the field then collected on the tree and ground as BUNI

ii. Berries can be picked and dried on the sun in raised trays.

Wet method (Arabica)

- Cherries are fed with water into pulping machine which separates beans from the skin.
- Parchment coffee is left for 2-4 days in fermenting gas where the sticky mucilage is removed by being broken down by enzymes.
- Beans are wished to get rid of the broken berry mucilage.
- Drying is done under the sun.

Yield:

Average 800kg/ ha-1250kg/ ha

NB:

- Robusta coffee is grown in low altitudes about 1100-1400m a.s.l the tree have vigorous growth has large coarse leaves with convagated surface contrary to Arabica which have flat surface.
- Robusta has characteristics (features) of heavy bearing, if it is not attacked by many pests and diseases.
- Many growths leave the tree unprunned because the tree does not suffer from over bearing as for Arabica.
- The crop is sold as sundried cherry which is hulled at factories.

Yield:

1900kg/ ha or more

TEA

Scientific name: Camllia Sinensis

Variety:

- Sinensis

Camellia Sinensis variety

- Sinensis Assamica

Origin: China

Major producers include- India, Taiwan, Argentina, China, Kenya, Thailand, Malawi, Mozambique, Uganda, Zaire, Mauritius and Tanzania.

Distribution in Tanzania

- Tukuyu, Mbeya, Mufindi.

Uses

- Used as a beverage
- For medical purposes. (Extraction of fluorine)

Characteristics of ASSAM tea Camellia sinensis var assamica

- Grow up to 9m high.
- Adapted to tropics.
- Have high fast growth
- High yield
- Have pale green leaves.
- Flowers are born in clusters of 2 and 4.

Characteristics of CHINATEA Camellin sinensis var sinesis

- Dwarf, never grow than 4.5m
- Adapted to sub-tropics.
- Low growth rate
- Narrow leaves which markedly serrated
- Dark green leaves
- Low yield
- Flowers born singly

ECOLOGICAL REQUIREMENTS

- Altitude: Grown in high altitude since it demand acidic soils and high rainfall (about the height of 1500-1800m a.s.l)
- Temperature: 20-25c
- Rainfall: 1500-1700mm/ annum
- Soils: Well drained pH 4-6 (acidic soils)

FIELD MANAGEMENT

Propagation

- Seeds
- Vegetative

Using seeds

- Seeds should be obtained from plants with desirable (good) qualities.
- Tea seeds germination is uneven due to roughness of seed coat, so pre-germinations necessary for ensuring uniform (even) germination.

NB:

- Seeds usually have a high segregation, so cuttings are more preferred.
- Seeds are selected by floatation test where seeds are immersed in water for 24 hours, all seeds floating are discarded.
- Seed should be pre-germinated by covering them with wet sacks, and then planted in the nursery beds about 2.5cm at 13-15cm spacing.
- Seedlings are ready when they attain 12-13cm thickness after 2yrs

- Seedlings are lifted from the ground and the part which is above the ground is cut to 10cm stump.

Qualities of good mother plant

- Should have dark green leaves.
- Should not be too brittle.
- Should have an ability to repair the dam aged tissues quickly.
- Should have less number of Banjhi shoots (not more than5)
- Plants with too much hair on their leaves should be discarded.

Cuttings

- Mother trees are allowed to grow for about 6 months after pruning thus providing long stems for cutting.
- Single leaf internodes cutting are usually used. The top 2or 3 internodes of each stem and the portion towards the base of the stem should be discarded.
- The top cut must be made near the auxiliary buds as possible and the lower cut must slop/ slant.
- Cuttings are planted in the polthene sheet as tube of 25cm disturbances.
- Cutting are ready for transplanting in the main filed when the roots reached the bottom of the sleeves and when 20cm high. This is attained after 6-10 months in the nursery.
- Cuttings are immersed in water to maintain the same turgidity before planting.

Land preparation

Site selection

Avoid-heart site (settlement)

- cattle bomas
- charcoal burning site

This is because they have high pH level.

- Holes are dug at a depth of 30cm and size is 30cmx30cm at a spacing of 1.5mx0.7m or 1.2mx0.9m.
- Shade trees should be planted along field boundaries; common shade trees used is Hokea saligna, Gravellia Robusta or Spathode nilotica (Africa Nandi flane)

Fertilizer application

- 1132 of leaves take 62kg of N from the soil hence N application is important. This has to be applied 3 months after planting until the crop is at economic level using NPK at a ratio of 25:5:5.

NB: CAN fertilizers should not be used as it limit the uptake.

- Phosphorus (P) deficiency leads to Die back while potassium (K) deficiency leads to scorching effects i.e. leaves turn dark green with dark brown margins and later defoliate.
- Sulphur (S) deficiency results to yellowing leaves.
- Nitrogen fertilizer (i.e. NPK) should be applied 110-120kg N per hact and Phosphate fertilizers should be 27kg P2O5per hact.

MULCHING

It is important at early stages, but later stages, plant provides their own mulch when pruning is done.

Pruning/ frame formation/ plucking table

The process falls under two stages.

i. Formative

ii. Pegging

I. Formative stage (frame formation)

This is done by stimulating lateral growth to grow sideways so as to have a wide and continuous frame for plucking table.

- This starts when plants reaches 30-35cm after one year, the plant is cut 15cm from the ground.
- Lateral roots will grow and left to attain a pencil size thickness, the plant is cut down to 27cm from the ground.
- It takes 2-3 yrs to reach the convenient height.
- Generally 12cm-13cm is added every year until the plant reaches 60cm tall.

II. Pegging

- After formation of the frame new shoots are allowed to grow for 3months. These are remo0ved by the process known as TIPPING (This is the removal of 3 leaves and a bud from the tips of the shoots which grow above the require height)
- This process is done by hand and a wooden frame is used to give a correct tipping height.
- This is done at 2-3weeks interval. The maintenance foliage should be 20cm-30cm deep.

- Pegs are prepared for each shoot to be pegged.
- Two rows of branches on either side of the stem are pegged such that the stem radiates outwards.

MAINTENANCE COLLAGE

Removal of Bhanjhi shoots

These are dormant shoots with hard leaves due to prolonged production of several leaves. These shoots have to be removed once they appear above the plucking table.

Pests

- Leaf minor
- Trips: They sack the cell sap of the plant and cause leaf defoliation.
- Mites

Disease

- In East Africa only Armillaria root rot which cause root decay is common.

Control:

- Proper land preparation
- Removal of affected plants.

HARVESTING (TEA PLUCKING)

Plucking: This is the process of tea harvesting.

Methods of Plucking

i. Fine plucking: This involves tipping 2 leaves and a bud. This produce high quality tea.

ii. Coarse plucking: This involves picking more than two and a bud. This reduces plucking frequency.

iii. Hard plucking: This involves breaking of the tip of the shoot exactly the height of the plucking table.

This reduces the depth of the maintenance foliage.

iv. Light plucking: This involves picking 2 leaves and a bud after 3 leaves have been produced above the plucking table. This can be done once or twice on year.

NB: Plucking interval is 5-7 days depending on the condition and method of plucking used.

YIELD: Average 1500kg of leaves/ hect

CARDAMON

Scientific name: Celettaria Cardamomum

Uses:

- Dry cardamom fruits are used as spice.
- It is used as medicine.
- Leaves are used for flavoring bread, cakes etc.
- It is used as aromatic stimulant in some beverages e.g1. tea
- It is used in preparation of some cosmetics.

Distribution

- Tanga, Zanzibar, Rungwe (Mbeya)

ECOLOGICAL REQUIREMENTS

- Altitude: Ranges from 750-1500m a.s.l
- Rainfall: 1500mm-2500mm p.a.
- Temperature 10c-30c
- Soils: Deep fertile soil well supplied with humus
- pH should be slightly acidic or slightly.

PROPAGATION

- It can be propagated vegetative by division of rhizomes in small scale production.
- Also seeds can be in large scale production.
- Seeds are collected from fully ripe capsules (fruits) and then dried in shade and sown immediately. The mucilage can be removed by rubbing in ashes before drying them up.
- Seedlings are transplanted when they are about 15cm tall (usually 3-4 months) at a spacing of 1.5mx3m.

FIELD MANAGEMENT

- Consists of weeding, mulching, removal of old and dry stems, filling the gaps, regulating the shade and manuring.
- Cardamon come to bearing 3years after transplanting and full bearing 4-5 years after planting.
- The economic life of cardamom is 10-15 years.

Pests

Thrips: (Thrips tabaci) Damage: Suckle the cell sap.

Control: Use of insecticides e.g. Dursban, Dursam.

Diseases

a) Leaf rot: Caused by bacteria

Damage: Causing rotting of leaves

Control: cultural practices e.g. field hygiene, crop rotation.

b) Mable disease

HARVESTING

- The fruits are harvested just before they fully dry in order to prevent the capsule from splitting when left fully dry.
- Fruits are sun dried or treated artificially by heat.
- Dried capsules are winnowed to remove pedicels and foreign material.

YIELD

Dry capsule; 112-200 kg/ hect/ annum

Market: towns and lockets exported.

COCONUT

Scientific name: Cocos nicifera

Origin: Asia and South Europe (East India)

Distribution in coastal areas like Tanga, Dar es Salaam, Morogoro, Pwani.

Varieties

Classified according to height.

a) Tall varieties

i. Most popular in East Africa.

ii. Germination of the nut occur after 2 ½-3 months.

iii. Have strong stems which can grow up to 35m early.

iv. They can produce 50-80 nuts/ year for 60-100 years

v. First bearing is after 6 or 5-10 years

vi. Maximum period is after 9-10years

vii. Produce big sized nuts with thick copr1a and high oil content.

b) Dwarf varieties

i. Takes a short time to germinate 1 ½-2 months.

ii. Economic life is short i.e. 30-40 years.

iii. Maximum production starts 5-6 years.

iv. Have small nuts with thin copra and low oil content.

v. Produce 150-200 nuts/ year

vi. There are preferred because of easy harvesting, high yield, resistant to lethal yellow disease

Disadvantages of dwarfs

- Susceptible to strong winds and dry conditions.
- Susceptible to rhinoceros beetle because they are succulents.
- Limits inter-cropping.

Examples:

Tall: East African tall, West Africa tall, Polynesian African tall.

Dwarf: Malaysian yellow dwarf, Malayan red dwarf, Cameroon yellow dwarf, Brazilian green dwarf, Equatorial green dwarf, Mawa, Camwa

Uses:

- Oil, which is obtained from the white flesh of mature dry nuts i.e. copra (contains 65-70% oil) which used for cooking of tening the slanets.
- Coconut juice (milk) for drinking.
- Palm wine (mnazi) is extracted from un opened (young) influence.
- Leaves can be used for thatching and making baskets.
- Midrib of leaves can be used for making fences also for fire wood and making of brooms.
- Making of mattresses from course brown fibres.
- The endocarp can be used in making cups calabashes.
- Poles can be used for building houses

ECOLOGICAL REQUIREMENTS

- Altitude: 0-1000m a.s.l.
- Rainfall: Well distributed of over 120mm per annum optimum 2500mm.
- Temperature: 27c- 28c
- Soil: Deep well drained and aerated light sandy soils with pH of 5.0-8.0

PROPAGATION

Nursery:

- Should be near permanent source of water.
- Select medium sized nuts since they absorb water faster.
- Plants in trenches (horizontally) leave a small portion unburned.
- Frequent irrigation should be done.
- Seedling is ready for transplanting when they produce 6leaves (2 month old).

Main field:

- Old stumps and leaves should be burned to control rhinoceros beetle.
- Mix FYM, TSP, CAN, MCPA, Magnesium Sulphate in 6-12m (hole)
- Spacing: 9x9 tall varieties, 7x7 m short varieties.
- Depth: deep, there can be 120-140 plants/ hectare

Preparation and planting

- Propagation by seeds “seed nuts” planted in nursery trenches where seedling is maintenance for 9-12 months when they have 3-4 leaves.
- Transplanted at beginning of rains. Holes 60cm are dug someday in advance. Nuts of seedling are planted 30-45cm below surface.

Field maintance

- NPK 500g/ tree/ year.
- Nitrogen should be applied to increase number of flowers.
- Weeding done around the stem using hand hoes.
- Herbicides application e.g. Paraquat, atrazine.

Pest and Disease control

Pests

1. Rhinoceros beetle: Orycytes monocerous

Damage:

- Stuck the terminal bud.
- Destroy the unopened leaves and the growing point.
- When attacked leaves open they produce v-shaped notches.
- Leaves dry up.

Control:

- Destroy all decaying trucks, stems, leaves by burning.
- Using wire to pierce the beetle.

2. Coreid bug: Pseudotheraptus wayii

Damage: -Suck the juice on young nuts and cause cracklings on the nuts and drop off.

Control: -Biological control by Ocephylla Longinoda i.e. Majimoto ants

3. Termites and other sucking insects.

Control: - Dust with Aldrin around trees.

Diseases

i. Bole rot

Cause: -Fungus Marasuniellus- Cocophilus

Symptoms: -Yellowing of leaves and wilting of plants

Control: - Avoid damaging the roots.

-Avoid infected seedlings.

ii. Lethal yellow disease (viral)

Symptoms: -Light brown irregular lesion starting at the tip of young leaves.

Control: -No chemical control.

-Uproot affected plants.

Harvesting and produce yield:

-First bearing 5-10 years after transplanting.

-Full bearing 10-18 years

-Nuts harvested 7-10months after flowering.

-For copra production, harvesting at full maturity.

Yield: -15-30 nuts per tree

Products from nuts

- Margarine, oils, soaps, mattress struffing, baskets, etc.
- Dried leaves are used to thatch mats and baskets.

CASHEW NUTS

Scientific name: Anacardium Occidentale

Origin: America

Distribution: Ruvuma, Lindi and Tanga in Tanzania

Uses

- Cashew nuts apple is used in alcohol brewing.
- The apple can be eaten as it provides vitamins to the body.
- The stems and branches once dry are used as firewood.
- Nuts can be used as food.
- Roots used as medicine
- Provides the country with forex when sold to outside countries especially cold countries because of oils content used to keep the body warm.
- Provides us with oil.

ECOLOGICAL REQUIREMENTS

- Altitude: 0-750m a.s.l.
- Temperature: favors temperature up to 35c
- Rainfall: 750-900mm per 1annum
- Soil: Well drained soil with acidic pH 4.5-6.5 i.e. acidic soil

PROPAGATION

The crop is directly propagated using the seeds e.g. the nuts. Also the crop can be propagated by air layering and grafting methods but the use of seeds is more preferable, it should be noted that heavy seeds are most viable. Seed beds are first prepared and these require careful clearing and burning well before sowing.

Sowing is done at the beginning of rains Holes are dug 30cm wide and 5.0-7.5cm deep, seeds are planted 2.5cm apart in each hole. Spacing is 12mx12m or 15mx15m

Field management

- Temporary shades are provided over young seedlings.
- Thinning is done to one plant per hole after one year.
- Pruning might be necessary in the first three year.
- Weeding around trees helps during harvesting.
- Fertilizer/ manure application is not important or essential for the crop since the crop undergo intense (massive) foliage i.e. dropping of many leaves on to the ground, this act leads to the formation of humus as the leaves decomposes on the ground thus, there will be addition of nutrients in the soil hence no need of adding nutrients by the use of manure nor fertilizer.
- But if deficiency of an element e.g. boron deficiency fertilizer containing required amount of the element needed.

Pests and diseases

Pests

i. Sucking insects e.g. helopelts bug

Damage: These suck the cashew apple

Control: Use of DDT and BHC sprayers or dust Diseases

Harvesting:

- First bearing if after 3 years.
- Full bearing is after 8-10years from sowing.
- After the fruit has (cashew apple) ripened, It drops down to the ground together with the cashew nut whereby it can be collected.
- When the cashew nut apple may be left on the ground where it may or may not sprout (develop into a seedling) when splashes of rainfall are present or if the cashew apple is collected it may be eaten or may be used in alcohol brewing.

Processing

- A place where cashew nut processing is mostly done in Tanzania is TANITA
- After the cashew apple and the cashew nut drops on the ground, the nut is taken and dried for 3-4days.
- Roasting is done after the crop is already dry
- Take off the outer cover i.e. separate the kernel (the eaten part) from the outer cover by bursting it thus after busting take of the kernel and the cashew nut "Kernel" is ready for eating.

Yield

600kg-1000kg/ hect or 590-1100 kg/ hect

NB: For a better quality outcome of the crop (products) motorized sprayers containing sulphur compounds to be used to kill the sucking insects which hinders the crops production.

LIVESTOCK PRODUCTION

THEME 2.0: LIVESTOCK PRODUCTION

IMPROVEMENT OF LIVESTOCK BREEDS

Introduction: The goal for keeping animals is to produce animal products which are sufficient and qualities enough.

- So as to achieve, this livestock keepers, must have good quality animals, feeding them well and keep them healthy.

Livestock Improvement

The productivity of farm animals is set by INHERITANCE i.e. passing of genes from parents to off springs however the environment determines how much the inheritance potential is going to be reached. So livestock improvement is therefore the program that set out to improve the inheritance of the environment in which they are kept.

Concept of inheritance

Inheritance deals with the mechanism by which characteristics of parents are passed to the off springs. The mechanism of inheritance resides in the sex cells (gametes) in both males and females which contain CHROMOSOMES carrying units of inheritance called genes.

- Chromosomes occur in pairs in the nucleus the number of chromosomes e.g. Cattle -30, Sheep -27, Pig -19, Chicken -39
- The members of each pair are called HOMOLOGOUS CHROMOSOMES.
- Genes are located in specific units of chromosomes called Locus.
- The genes located at the some loci of chromosomes pair are alleles.
- If they have the same effect are called homozygous.
- If they have different effects (antagonistic) are called heterozygous.
- Sex cells undergo cell division whereby the cell divides to form daughter cells with half number of chromosomes from parent cells.
- So the male and female gametes when fused together during fertilization the chromosomes number is restored. Off springs formed receives genes from both.

The concept of heredity

This is a numerical measure of the portion of total variation among animals in particular characteristics that is caused by genes the animal posses. It is expressed in%

e.g. the heredity of certain character is 50% means all the differences between the animals in the herd as for that character is concerned will be 50% genetic and 50% environmental.

Significance of knowing hereditable of a character

i. Help the breeder to be able to select the best breeding method.

ii. Help to estimate the expected progress towards environment of animals.

Table to show heritability of dairy cattle

Character	Heritability
Milk production	25%
Dairyconformation	20%
Butterfat	60%
Matureweight	60%

THE CONCEPT OF BREEDING

Breeding: Is a way of changing the genetic constitution of animals for future generation.

Objectives:

i. To increase yield of meat, milk, eggs etc

ii. To improve disease resistivity.

iii. To improve resistance to dry/ hot climate.

Methods used to improve Genetic makeup of an animal

i. Selection

ii. Making system (out breeding and in breeding)

I. Selection:

Is the process of allowing certain animals to be parents of the future generation

- Animals with undesirable characteristics are sold while those with desirable characteristics are retained.

Advantages

Selection increases the frequency of the desirable genes and decreases the frequency of undesirable.

Disadvantages

If desirable genes are lacking in the herd selection will not introduce them so it becomes ineffective tool for livestock improvement.

NB: Selection requires skills, proper keeping of records of the performance of animals and monitoring of the performance of its progeny.

II. Mating system

It is a system where the breeder decides which sire (male) is to mate with bome (female). This is done after the selection of the breeding herd.

Types of Malting

a) Out breeding

b) In breeding

OUT BREEDING

Is a system based on unrelated sire and bomas.

Objective of Outbreak

- To introduce new genes into the herd e.g. Zebu cattle cracks genes for high milk yield but Friesian have this gene, So by mating a Friesian bull to a Zebu cow the heifer are raised from the union will inheritance the high milk yield from the Friesian sire genes.
- To obtain a hybrid vigor i.e. when un related sire and dame are matted the offspring grows faster than the parents.

IN BREEDING

Is a system based on mating related sires and dam

Objectives of In breeding

- To make sire and dame of the same herd to selectively, transmittable characteristics.

Advantages:

i. Increase the number of homozygous pairs of genes for characteristics.

ii. Increase uniformity of the herd i.e. pure line is obtained.

Mating systems methods

i. Natural system

ii. Artificial Insemination

I. NATURAL SYSTEM

Takes place by allowing mating i.e. copulation by penis. It is done when the female shows signs of heat.

II. ARTIFICIAL INSEMINATION

- It is done by trained inseminator who introduces selected semen to the reproductive duct of the dame using special instrument.
- The semen is obtained from the sire using artificial vagina and teaser animal and stored in a deep frozen tube.

- The semen can be diluted and used to inseminate 50-200 dames from a single male sire.

Advantages

- It reduces chances of spreading viral diseases which might be spread by the male.
- Semen from high quality sire can be made available at a low price.
- The transportation and distribution of semen is easy since they are stored in a small container while in natural system involving movement of the sire.

Disadvantages

- Require skills.
- If not done well semen from heavy breeds may be introduced to light breeds hence bringing problems during birth.

Livestock breeding stations in Tanzania

i. Kitulo- Iringa

ii. Uyole – Mbeya

iii. Mpwapwa – Dodoma

iv. Tengeru – Arusha

v. Maruku – Bukoba (Kagera)

vi. Mabuki – Mwanza

Principles of good livestock breeding

i. Selection of desirable sires and mates

ii. Care of sires and dames before service.

iii. Breeding at proper age.

iv. Servicing (coition) at the right time.

v. Appropriate breeding system.

vi. Care of pregnant animals up to parturition time.

vii. Care of young animals

viii. Castration of un required male animals.

ix. Culling.

FISHERIES

This refers to the process of producing and rearing fish- fish farming.

- This is done by keeping fish in aquarium or tanks or by breeding fish and then release them into dams, ponds and rivers.
- Any fish reared must be adaptable to the climatic condition of the area.
- It is advisable to construct a fish pond on a level ground and near a source of water e.g. river, steam.

- A fishpond should be able to hold water throughout the year.
- Avoid slope places and porous soils e.g. sand soil is not suitable while clay is the best.
- It should neither be too shallow nor too small at least 1.5m deep 20-25cm wide.

- Walls of the proud should be raised and grass should be grown on the walls to make the soils firm.
- Enough nutrients should be available in the pond water for the growth of aquatic plants.
- The pond should be protected from pollutants.

A fish pond should have

i. Inlet where water enters the pond.

ii. Spill way; which allows overflowing water to flow back into the river.

iii. Outlet pipe; At the bottom of the pond for draining water.

iv. Fence; for keeping away thieves, animals and other creatures from polluting the pond.

Significance of fish farming in Tanzania

- Provide high quality protein.
- Provide employment and recreation.
- Source of income.
- Source of foreign exchange.

Main types of fishers

i. Marine fisheries.

ii. Fresh water fisheries e.g. Pangani and Rufiji estuaries are also sites for prawns.

Common species/ Fish types in East Africa ponds

- Trech, back base, cat fish, tilapia and trout etc.
- Catfish is well adapted to fresh water.
- Tillapia is the most preferred by e.g. T. sparrmani, T. galilae, T. heudeloti, T.esculanta, T. leucostica, T. andersomii etc.

Advantages of Tillapia

- Local consumers are accuctomed to their taste.
- The climate is good to them i.e. 20-30c with an exception of T. sparrmani can stay even at 8c
- Young fish for stocking are readily available.
- They are either omnivorous or herbivorous hence easy to feed.
- They breed and grow fast.
- They are affected by few parasites.

Characteristics of Herbivorous Tillapia

- They eat plants.
- Have high production potential examples Tillapia tholon, Tillapia zillii

Characteristics of Omnivorous Tillapia

- They eat both plants and animals like snails, mosquito larva and worms.
- They keep their eggs in mouth until they hatch i.e. mouth incubating practices, examples; T. macroch, T. mossambia, T. rulotica, T. nigra.

FEEDING

- They should be fed daily, may be fed with commercial feed i.e. pellets, rich bran, ground nut cake, maize bran.

- Don't overfeed the fish as it can reduce the supply of oxygen, feed according to the pond size.

HARVESTING

- Is done when the fish are matured e.g. Tillapia 8 months are ready with a length of 20-30cm long.

Methods:

i. Hook and line methods

ii. Catching nets.

iii. By draining the entire water pond.

iv. By use of cast with appropriate sized mesh.

Diseases and Parasites of fish

- Most of the fish die because of pollutants which causes diseases as such when they decompose they infect the pond with diseases and thus spreading diseases.

- Certain birds hatch on ponds and they may spread diseases.

Care and Maintenance of the ponds

- Should be fertilized twice a week.

- Water lever should be checked.

- Grasses and weeds around fish pond should be slashed.
- Repair the wall if there is any leakage.

MARKETING

- Local and town markets.
- Some are exported.

STORAGE

- Stored in frozen state.
- Stored when dry under the sun after removal of offal and scales.
- Salting and drying.
- Smoking.

FARMING BUSINESS ECONOMICS AND AGRICULTURAL EXTENSION

THEME 3.0 FARMING BUSINESS ECONOMICS AND AGRICULTURAL EXTENSION

AGRICULTURE MARKETING

A market is a place where buyer and sellers meet and exchange goods/ service.

- Is a place where forces of demand and supply interest.

Agriculture marketing is the performance of all business activities that are involved in the flow of agriculture goods and services from the point of initial production until they are in the hands of the consumer.

Aim of Efficient Marketing

- To deliver goods and services to the consumers at the place and time they are wanted in the form they are wanted and at a price consumers are willing to pay.

MARKET FUNCTIONS

a) Exchange function involves

i. Merchandizing: Is a process of buying and selling goods i.e. purchasing in small lots from producers and bulking up the commodity and presentation of the products/ goods in an attraction manner to the consumers and bargaining for an advantageous price.

ii. Price setting: Usually the sellers set the price at which to sell their products. Marketing conditions i.e supply and demand, pricing policies, competition are considered on setting the price.

b) Supply function involves

i. Processing i.e. changing the products from its raw from to a more easily utilizable form.

ii. Transportation of goods.

iii. Financing and insuring i.e. marketing agencies borrow the necessary capital from public and commercial institutions e.g banks for financing activities of buying and selling.

iv. Collecting and analyzing market information.

v. Grading and standardization.

vi. Storage to prevent wastage of excess products.

c) General function involves

i. Financing, organizing and book keeping. To keep financial accounts of the business, transactions, organizing marketing process, bear the cost of doing all operations in marketing process.

ii. Risk taking, marketing institutions has to insure the goods to minimize the risk.

iii. Collection, provision of marketing news and information (sales promotion) Market and product information enables consumers to make consumption decisions and producers to make production decision.

iv. Grading and description of products so as to satisfy the requirement of different consumer groups.

v. Processing.

Marketing

Channels and agencies

Normally the people who handle goods from producers to consumers i.e. middlemen some buy goods from producers and sell to other middlemen, while others sell to consumers.

PRODUCERS - Whole sale – Retailers – Consumers

Types of middlemen

i. Whole sales: They buy goods in bulk from producer and manufactures; store them for sale in large quantities.

ii. Retailers: Handle goods and sell them to look for (find) consumers.

iii. Jobbers: Buy goods from whole sales and distribute to retailers, normally they travel from one place to other

iv. Brokers: Doesn't take title to goods just represent the buyers or sellers and brings them together or arrange transactions between them.

v. Cooperatives: Are non-profit organization set up to serve consumers and producers. They operate on the principle of "one person one vote"

vi. Commission agents: People who sell goods and services and receive a commission i.e. % of the selling price.

vii. Manufactures and authorities: These are parastatal organization established by parliamentary acts to deal with production or market of a specific crop or livestock.

CLASSIFICATION OF MARKETS

This is done on the basis of competition and price, these are six classes

1) PURE/ PERFECT COMPETITION

CHARACTERISTICS

- They are many sellers and buyers of a particular product.
- The sellers and buyers sell/ buy similar products.
- All sellers/ buyers have equal knowledge of market condition.
- No seller/ buyer can influence the market price.
- The demand curve for each buyer/ seller is perfect elastic.
- Each seller makes small profit because of strong competition.
- The price of products is determined by the forces of supply and demand.

2) MONOPOLY COMPETITION

Monopoly may be formed due to the following reasons:

- Protection by the government.
- Control of source of raw materials by one firm.

- In most cases, the monopolist produces low amount of output in order to keep the prices high.

CHARACTERISTICS

- There is a single seller in the market i.e. monopolist.
- Monopolist can rise or reduce price depending on the amount of profit and volume of sales in one year.
- Produces low amount of output in order to keep prices high.

3) OLIGOPOLY COMPETITION

CHARACTERISTICS

- There are several firms selling similar products.
- The number of firms is so small that each firm sells a substantial share of the total output.
- When one seller changes price, he affects the sale of his competitors to a price and output level after studying the prices and output level of other products

4) MONOPOLISTIC OR IMPERFECT COMPETITION

- Sellers lower prices in order to sell more; also they use to attract customers (buyers) by placing labels.

5) MONOPOLY CHARACTERISTICS

- There is a single buyer of a particular resource.

- Supply curve of the resources is upward sloping i.e. perfectly in elastic.
- Monopolist profit by restricting the quantity of resources he uses while paying a price that is lower than the prices that would prevail under conditions of pure competition.

6) BLACK MARKET

Result due to:

- Scarcity of the product in question.
- Price control by the government.
- Rationing of the product.

CHARACTERISTICS

- Involve high costs and risks; therefore the price is higher than prices on the open market.
- Not all potential buyers are willing to buy on the black market.

NB: Market margins and costs are the costs of performing the marketing functions i.e. difference between what farmers get consumers prices.

CO-OPERATIVES

A cooperative is a voluntary business organization which operates on the principle of one man vote. It aims at minimizing costs and maximizing profit.

TYPES OF CO-OPERATIVES

1) Marketing or producer co-operatives.

2) Consumer co-operatives

3) Saving and credit co-operatives

4) Multi-purpose co-operatives

Function / objectives of co-operatives

- To give consumers bargaining power so as to get lower prices of the goods they buy.
- To give producers coming together bargaining power so as to get better prices for what they produce.
- To give members bargaining power so as to get lower interest rates for the money they borrow.

Benefits farmers can get from co- operatives

- Co-operative marketing reduces middlemen profit so that farmers get larger shares of the sale prices.
- Improve the bargaining power of farmers for better prices.
- Farmers can sell in bulk.
- Co-operatives perform storage and processing facilities hence reducing wastage of farmers produce.
- Bulk handling of produce facilitates better grading and packaging standards.
- Useful in channeling inputs and credits to farmers.
- Act as extension agents to the farmers.
- Facilitate smooth marketing of the farmers produce.

Types of co-operative societies

- Agricultural co-operatives- deals with crop production, purchasing, processing, market distribution.
- Livestock co-operative societies.
- Producer co-operatives for agricultural forestry, bee-keeping and other natural products. Formation and organization of co-operatives

According to the of the cooperative societies act 1991, the structure of co-operative shall be determined by the members.

Levels of marketing co-operatives in Tanzania

1) Primary cooperatives
2) Secondary cooperatives
3) Apex cooperatives
4) The federation of the cooperatives

1) PRIMARY CO-OPERATIVE SOCIETIES

May be formed by ten or more farmers provided its economically viable, has to be registered by the registrar

Functions

- Preparation of economic plans of the society and coordination of all production activities.
- Purchasing storage and distribution of agricultural inputs.
- The provision opera1tion and maintenance of machinery for processing of Agricultural products.

- Purchasing collection and storage of products from member's cooperative society.
- Establishing large scale farms.

2) SECONDARY CO-OPERATIVE SOCIETIES

Formed when primary co-operative societies unite the society formed is known as a co-operative union.

Functions:

- To acquire, maintain and operate buildings and equipment for assembling ware house and transporting of products belonging to members.
- To produce and distribute inputs and consumer goods to member primary cooperative societies.
- To provide finance for the purchases of agricultural products from its member cooperative societies.
- To collect, process, deliver products from primary societies for marketing.
- To establish and operate and savings and services to all its members.
- To establish, operate and maintain large scale farms for age products.
- To provide, audit services for member societies.

3) APEX CO-OPERATIVE SOCIETY

Formed when 2 or more secondary co-operative societies unite.

Functions:

- Organizing and coordinating activities of the member secondary societies.
- Providing services to the member secondary societies e.g. standardizing their book keeping auditing
- Publishing, printing and circulating newspapers, booklets regarding co-operative principles.
- Representing member societies in collective bargaining.
- Providing consultative services to member societies.

4) THE FEDERATION OF CO-OPERATIVE

Apex societies may join to form a federation of societies.

Functions:

- Coordinating economic plans of the member societies then forward them to the minister (for natural plan).
- Formulating, maintaining and regulating the terms and conditions of services of persons employed in the apex societies, secondary and other countries.
- Encouraging educational and advisory work related to cooperatives enterprises.
- Representing member societies in International conference. Structures of Agricultural marketing co-operatives

Farmers in a village are two/; May form primary cooperative society in which can buy their produce, large number of co-operative societies.

Procedures for starting a co-operative

- Formed under a co-operative society ordinance.
- Each co-operative makes its own by –laws under the rule of co-operative society ordinance. The rules are approved by registrar of cooperatives.

Principles of Co-operatives

1. One member on vote is democratic; each member is entitled to one vote in each decision taken by the society.
2. At general meetings, members elect a committee for the following functions:
   - To elect one of its members to be a chairperson.
   - To elect secretary.
   - To elect treasurer
   - Employ and dismiss employees of co-operative.
   - Oversee day to day business
3. Each co-operative society admits members without discrimination.
4. Each co-operative society aims at selling goods in pure and clear form.
5. Each co-operative society aims at selling goods at current price.
6. The surplus is distributed to members on the volume of business transactions done with the co- operatives.

MARKETING BOARDS

- These are marketing organizations formed by the government to protect producers and consumers interests and to control economic development in the country.

Functions

- Improving marketing organization and methods done by regulating quality and packaging standards, sales procedures.
- Protecting produces and consumers against price fluctuations.
- Protecting government interests.
- Obtaining funds for sale production research and extension.
- Carrying out research and sales promotion.
- Improving bargaining power of producers on both, the foreign and domestic market.
- Standardizing (stabilizing) prices using buffer stocks or stabilizing funds, international agreements etc.
- Administering laws to maintain quality and standard of commodities.
- Ensure steady supply of agricultural products to consumers.
- Promoting production by taking part in actual production.

INTERNATIONAL TRADE

- It is the exchange of goods/ services across different countries/ nations.

Significance of I international trade

- Trade between countries allows each country to specialize in the production of certain goods.

- Trade between countries enables to obtain products that can't be easily raised in their country.
- Cause countries to specialize to crops in which have comparative advantages to other countries hence stabilize higher prices.

NB: Payment in international trade is settled in foreign currency and exchange of goods is done across borders of nations.

Terms used in international trade

- Terms of trade- ratio between price of export and of import.
- Balanced trade- ratio of the value of exports and value of imports i.e. difference between the values of Exports.
- Foreign exchange rate: Is the rate of exchange between the currency of one country to another e.g. Tanzania shs vs. Us dollars.
- Foreign reserves: Refers to the total value of resources (expressed) in Dollars, gold and Sores i.e. special

Drawing rights held by a certain country

These acts as reserve from which international payments are made

Effects of international trade prices of economic developing cost

- For example Tanzania as other developing countries depends on primary agricultural commodities such as coffee, sisal, tea, cotton, to get foreign exchange. Market for such commodities are very unstable because have low income elasticity of demand.

- The cost of imports for raw materials expand each year exceeding our exports so we get a problem in "Balanced of payment" i.e. difference between total income and total expenditure.

- Prices of our exports are not rising as much as the prices of imports so the terms of trade are getting worse.

NB: Generally developed nations benefit more from trading with UN developed countries/ developing countries.

International commodity agreements

There are some products which have many problems in the World market such as unstabilized prices. E.g. coffee, tea, sugar etc so the need of formation of international commodity agreements became necessary e.g. International coffee commodity.

i. To provide protection to countries which export the primary products against excessive production which may lead to low prices

ii. To protect the exploiting countries this exports the primary products against excessive competition among,

iii. To stabilize world prices for the products.

iv. To set overall out levels for all countries which produce particular product in the World.

v. To allocate quota shaves to each producing country for a particular product e.g. coffee, tea etc.

BALANCE OF PAYMENT

It is a statement that shows a summary of the country's trading transactions with other countries in the

World.

- It consists of income side and expenditure side which must balance.
- The balance of payments account shows the total income and expenditure sides of the country for international transactions and the difference between them.
- If the difference i.e. expenditure in imports is low compared to the income obtained from exports.

Balance of payment account (A/C) consists of:

a) Capital account

b) Current account

Capital account

It shows the movement of capital transactions including

- Foreign loans.
- Foreign investment.
- Foreign gifts. (Grants).

If payments of this is greater than what the country receives from other countries there is a DEFICIETY in the capital account.

If the situation is vice versa, surplus is generated.

Current account

It shows two main items.

- Visible
- Invisible

Visible: These are items which can be seen e.g. raw materials, manufactured goods, capital goods etc. Invisibles: These are services such as insurance, tourist services, banking, and interest on foreign loans and profit on investments'. They can't be seen physically.

When there is a deficit, the country can correct it by:

- Selling foreign investments.
- Asking debates (foreign countries) to pay back loans.
- Withdrawing from accumulated reserves e.g. IMF
- Borrowing from foreign governments, institutions, monetary fund's e.g. IMF

When there is surplus of current account, the government can use it in:

- Paying foreign debts.
- Granting foreign loans.
- Investment abroad.
- Adding to the reserve.

Problems of prolonged deficit in balance of payments

i. Devaluation of the local currency i.e. reducing the value of the country's currency in terms of gold and currency of other countries.

ii. Introduction of floating exchange rates (as opposed to fixed and constant exchange rates).

iii. Review of the country's fiscal policies such as taxation and subsides.

iv. Total ban on some imports.

v. Introduction strict foreign exchange regulations.

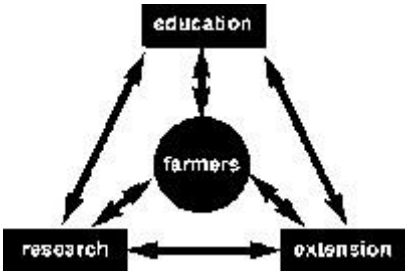
Problems of marketing agricultural products

- Seasonality.
- Storage problems.
- Perish ability.
- Bulkiness.
- Changes in market demand.
- Low state of knowledge about marketing.
- Limited elasticity of demand e.g. food products, food is generally basic and once the body has been fed to its capacity, there is hardly any room for more.

The demand for food increases with income only so long as income becomes the limiting factor to the food intake, after that the increase in demand may be limited only to certain food types such as meat, fruits, spices etc.

AGRICULTURAL EXTENSION EDUCATION

Agricultural extension is a general term meaning the application of scientific research and new knowledge to agricultural practices through farmer education. The field of "extension" now encompasses a wider range of communication and learning activities organized for rural people.



Diffusion and Adoption of Agricultural Innovations

Diffusion

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system.

There are four elements in diffusion process.

1. An innovation
2. Communication Channels
3. Time
4. Social system Innovation:

An innovation is an idea, practice or object perceived as new by an individual or other unit of adoption. Technology is a design for instrumental action that reduces the uncertainty in the cause effect relationship involved in achieving a desired outcome.

The components of technology are: Hardware (physical) and Software (knowledge base).

A good innovation should have following five attributes:

- Relative advantage
- Compatibility
- Complexity
- Trial ability
- Observability

Re-invention is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation.

Communication channel:

It is the means by which the messages get transferred from one individual to another. Mass media are good for creating awareness knowledge where as interpersonal channels are good for forming and changing attitude of the people towards technology.

Social System: It is a set of interrelated units that are engaged in joint problem solving t o accomplish a common goal.

Components of a Social System

1. Structure: It is patterned arrangement of the units.
2. Norms: These are the established behavior patterns.

Opinion leader's exhibit the norms.

i. Heterophily:

It is the degree to which pairs of individuals who interact are different in certain attributes, such as beliefs, education, social status and the like.

ii. Homophily: It is the degree to which pairs of individuals who interact are similar in certain attributes such as beliefs, education, social status and the like.

Time: It is involved in: Innovativeness, Innovation rate of adoption, Innovation Decision Process:

i. Innovation Decision Process:

It is the mental process through which an individual (or other decision making unit) passe s from first knowledge of an innovation to forming an attitude towards the innovation, to a decision to adopt or reject, to implementation of the new idea and to confirmation of this decision.

The steps in Innovation

I. Decision Process is:

a. Knowledge

b. Persuasion

c. Decision

d. Implementation

e. Confirmation

II. Innovativeness:

It is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system.

III. Rate of Adoption: It is the relative speed with which an innovation is adopted by members of a social system.

Adoption is a decision to make full use of a new idea as the best course of action available.

Rejection; is the decision not to adopt an innovation while

Discontinuance; is a decision to cease the use of an innovation after adopting it earlier. Discontinuance, then, is essentially adoption of an innovation, followed by rejection.

Discontinuance is of two types:

1. Replacement: Replacement discontinuance is a decision to reject an idea in order to adopt a better idea that supersedes it.

2. Disenchantment: Disenchantment discontinuance is a decision to reject an idea as a result of dissatisfaction with its performance.

Stages of Adoption

Adoption Process is the mental process through which an individual passes from first knowledge of an innovation to a decision to adopt or reject and to later confirmation of this decision.

Five stages of adoption process:

1. Awareness: At this stage an individual first hears about the innovation. This means that individual is exposed to an idea but lacking detailed information about it. This is somewhat like seeing something without attaching meaning to it.

2. Interest: At this stage individualism motivated to find out more information about the new idea. An individual wants to know what it is, how it works and what its potential may be.

3. Evaluation: At this stage mental trial of new idea takes place. An individual considers the relative advantage of the new idea over other practices/alternatives.

4. Trial: At this stage an individual tests the innovation on a small scale for himself. An individual seeks information about technique and method of applying the new idea.

5. Adoption: If satisfied with trial an individual will decide to use the innovation on large scale in preference to old methods.

Duration and length of time between any two stages varies with each practice and individual. The rate at which different individuals go through the different stages varies with the personal characteristics of the individual and the nature of the group influences on him.

Stages of Adoption Process as Used in Indian Researches

1. First information, most information and final adoption

2. Awareness, acquaintance and adoption

3. Awareness, trial and adoption

4. Awareness, knowledge, trial and adoption

5. Awareness, interest, evaluation, trial and adoption

6. Awareness, interest, trial, evaluation and adoption

7. Need, awareness, interest, deliberation, trial, evaluation and adoption

Adopter Categories

Adopter categories are the classifications of members of a social system on the basis of innovativeness, the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a system.

i. Innovators:

Innovators are also known as "venturesome". Venturesome ness is the salient value of the innovator. Innovators are very eager to try new idea. They have more cosmopolite social relationship. They have ability to understand and apply complex technical knowledge.

They have ability to cope with high degree of uncertainty about an innovation. They are risky, hazardous and daring in nature. They play gate keeping role in the social system. There are 2.5 percent innovators in a social system.

ii. Early Adopters:

Early Adopters are also known as "respectable". They are localities and have opinion leadership. Members of the social system consider them as "the individual to check with" before using a new idea. Change agents consider them as "local missionary". They hold "central position" in the communication structure of the system and are respected by peers. There are 13.5 percent Early Adopters in a social system.

iii. Early Majority:

Early Majority are also known as "deliberate". They adopt new ideas just before the average member of a social system. They seldom hold leadership position. They Provide "interconnectedness" in the system's networks. Motto of early majority is- "Be not the first by which the new is tried, nor the last to lay the old aside". There are 34 percent Early Majority in a social system.

iv. Late Majority:

Late Majority are also known as "skeptical". They adopt new ideas just after the average member of a social system. They adopt an innovation when they feel that it is safe to adopt. There are 34 percent Late Majority in a social system.

v. Laggards:

Laggards are also known as "traditional". They are the last in a social system to adopt an innovation. They are the most localities and isolates. They possess almost no opinion leadership. The point of reference for the laggards is the past. They interact with people having traditional values. They are suspicious of innovations and change agents. There are 16 percent Laggards in a social system.

Five stages of Innovation-Decision Process.

1. Knowledge:

At this stage an individual (or other decision-making unit) is exposed to the innovations existence and gains some understanding of how it functions.

2. Persuasion:

At this stage an individual (or other decision-making unit) forms a favorable or unfavorable attitude towards the innovation.

3. Decision:

At this stage an individual engages himself in activities that lead to a choice to adopt or reject the innovation.

4. Implementation:

At this stage an individual puts an innovation into use.

5. Confirmation:

At this stage an individual seeks reinforcement for an innovation-decision already made, but he or she may reverse this decision if exposed to conflicting messages about the innovation.

SOIL AND ITS UTILIZATION IN AGRICULTURE

THEME 4.0: SOIL AND ITS UTILIZATION IN AGRICULTURE

Soil fertility: is the capacity/ability of the soil to supply the plant nutrients required by the crop plants in available and balanced forms. Or it is the capacity of soil to produce crops of economic value to man and maintain the health of the soil for future use.

The soil is said to be fertile when it contains all the required nutrients in the right proportion for luxuriant plant growth. Plants like animals and human beings require food for growth and development. This food is composed of certain chemical elements often referred to as plant nutrients or plant food elements. These nutrients are obtained from soil through roots.

Plants need 16 elements for their growth and completion of life cycle. In addition to these, 4 more elements viz. sodium, vanadium, cobalt and silicon are absorbed by some plants for special purposes.

Classification and source of nutrients:

Class	Nutrient	Source
Basic	C, H, O	Air and water
Macro	N, P, K, Ca, Mg, S	Soil
Micro	Fe, Mn, Zn, Cu, B, Mo & CI	Soil

Four more recognized nutrients are NA, Co, VA & SI.

Basic nutrients (C, H, and O) constitute 96% of total dry matter of plants. Macro (Major) nutrients (primary-N, P, K, and secondary-Ca, Mg, S) are required in large quantities while

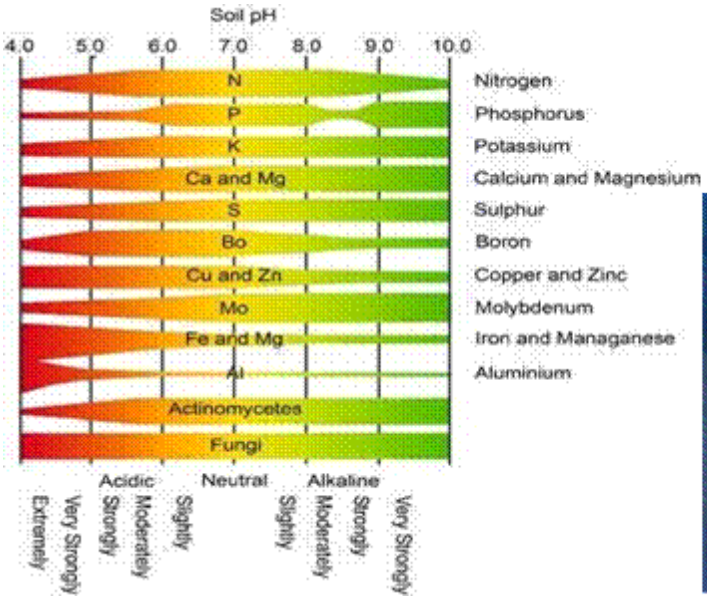
Micro nutrients (Trace elements-Fe, Zn, Cu, B, Mo, Cl, and Mn) are required in small quantities.

These trace elements are very efficient and minute quantities produce optimum effect. On the other hand, even a slight deficiency or excess is harmful to plants.

Soil reaction

Soil Reaction (pH)

From an agricultural standpoint pH is important because it strongly affects plant growth, nutrient availability, elemental toxicity and microbial activity. In an agricultural sense, soil pH indirectly affects plant growth.



This is because various mineral nutrients are readily available in varying concentrations depending on the pH of soil. At certain pH levels, certain mineral nutrients remain with other minerals and are unavailable to the plant.

For example and with respect to cotton, soil pH should be in the range of 5.5 – 7.0. If the pH is greater than 7, the availability of some nutrients such as zinc may become limiting. This may be

the case in the arid and semi-arid cotton growing areas where the soil is moderately- (i.e. pH 7-8.5) to strongly-alkaline (i.e. > 8.5).

Conversely, if pH is less than 5, the availability of some nutrients such as phosphorus, calcium, magnesium and molybdenum is very low and so plant uptake is limited.

In addition, some generally insoluble cat ions (e.g. iron and aluminum) may be released into the soil solution. The result will be reduced plant vigor owing to the sensitivity of many plant roots to aluminum toxicity.

Adjustment of soil pH will often result in the re-adsorption or release of the nutrient back into soil solution. It is therefore argued that pH is the single most important diagnostic chemical measurement of soil.

The term pH is short for potential hydrogen. This is because pH indicates the concentration of H+ activity in the soil solution. It is expressed as follows:

$$pH = -\log (H^+)$$

Soil Reaction or pH describes the acidity or alkalinity of a soil. The pH scale ranges from 0 -14. Values between 0 and 7 are said to be acidic with a pH value of 1.0 being very acid and a pH value of 6.0 said to be slightly acid.

Values between 7 and 14 are said to be basic or alkaline; whereby a larger number indicates stronger alkalinity. The value of 7 is the midpoint of the scale and is neutral. The pH of pure water is neutral.

Because the pH scale is logarithmic, going down the scale from a pH value of 7, each number is ten times (x10) more acid than the one before. For example, soil pH of 6 is x10 more acid than neutral (i.e. pH 7). Further, a soil with a pH of 5 is x100 more acid than neutral (pH 7). In other words the more hydrogen ions there are the more acid is the soil.

The range of soil pH (i.e. 95 % of most soil) is generally between 4 and 10. The distribution of acid and alkaline soil is in general a function of climate.

Acidic soil is most common where rainfall is high and free drainage favors leaching and biological production of acid. This is because most of the exchangeable cat ions of calcium, magnesium, potassium and sodium are leached. This process occurs because of the introduction of a weak (i.e. carbonic acid) into a soil profile in one of two ways.

In the atmosphere, as raindrops form and fall through the air, CO_2 dissolves in the rainwater to form carbonic acid:

$H_2O\ (aq) + CO_2\ (g) \leftrightarrow H_2CO_3\ (aq)$

This weak acid is harmless to plants and animals, but over a prolonged period of time it is able to dissolve rocks, like feldspar and limestone. This is because in soil solution and at pH values above 6, the carbonic acid quickly breaks down to liberate H^+ ions as follows:

$H_2CO_3 \leftrightarrow H^+\ (aq) + HCO^{3-}\ (aq)$

Now there is an excess of H^+ so this dilute solution is acidic with additional release of H^+ occurring as follows:

$HCO^{3-}\ (aq) \leftrightarrow H^+\ (aq) + CO_3^{2-}\ (aq)$

This is the reason why in equilibrium with the atmosphere water has a slightly acidic pH of 5.6. This is also the reason why naturally acidic soil types are found in high rainfall areas.

Carbonic acid is a weak acid is only partially dissociated to release H^+, whilst a strong acid is almost completely dissociated. Carbonic acid is too weak to dissociate much at pH < 5 but has significant acidifying effect in alkaline (pH > 7) and neutral soil where it can release plant nutrients and promote mineral weathering.

In addition and because soil organic matter (OM) production is generally greater in high rainfall areas, carbonic acid is catalyzed by micro-organisms.

Here bacteria mediate oxidation of decaying OM to CO_2. This oxidation reaction can be considered by representing OM by a simple carbohydrate (CH_2O). The overall reaction is as follows:

$CH_2O\ (s) + O_2\ (g) \rightarrow H2O\ (aq) + CO_2\ (g) \leftrightarrow 2H+\ (aq) + CO_3^{2-}\ (aq)$

Soil processes that push these reactions to the right include root respiration and decomposition of soil OM by microbes. In both cases high levels of CO_2 are produced.

As a consequence, the percolating water is slightly acidic and this gradually results in the acidification of soil. This is because the percolating water replaces and leaches soluble exchangeable cat ions (i.e. calcium, magnesium, potassium and sodium) out of the soil profile. The exchangeable cat ions have been replaced with hydrogen ions (i.e. H^+).

Conversely, alkaline soil (e.g. Calcarosol, Vertosol and Sodosol) is synonymous with arid and semi-arid landscapes where evapotranspiration exceeds rainfall, which favors retention and accumulation of exchangeable cations.

In these climatic regions the alkaline nature of the soil is a function of the calcium carbonate present in subsoil horizons.

The carbonate accumulates from carbonate rich dust ($CaCO_3$) which is initially blown onto the soil surface. As described above water in precipitation (H_2O) combines with atmospheric and soil carbon dioxide (CO_2) to make weak carbonic acid (H_2CO_3).

Calcium carbonate in and at the soil surface reacts with the carbonic acid. This dissolves $CaCO_3$ releasing Ca^{2+} (aq) making it mobile with both ions translocates deeper into the soil profile with percolating water:

$H_2CO_3 + CaCO_3$ (s) $\leftrightarrow Ca^{2+}$ (aq) + $2HCO^{3-}$ (aq) Dry conditions at depth lead to precipitation of secondary carbonates:

$$Ca^{2+} + 2HCO^{3-} + H_2O \leftrightarrow CO_2 + CaCO_3 \text{ (s)}$$

High pH therefore indicates the soil is fully saturated with exchangeable cations and free $CaCO_3$ is present in the soil. Soil profiles high in carbonate have pH values of approximately 8.3.

Carbonates (e.g. $CaCO_3$) may be in the form of concretions or diffuse areas. Effervescence with hydrochloric acid (HCl) suggests the presence of carbonates.

In order to measure pH, laboratory methods require the use of a glass electrode pH meter in a soil/liquid system of varying proportions. The liquid is either distilled water or a range of salts (e.g. 0.01 M Calcium Chloride - $CaCl_2$) with the soil: water ratio varying from 1:1 (i.e. pH1:1) to

1:5 (i.e. pH1:5).

A $CaCl_2$ solution is preferred (i.e. $pHCaCl_2$) as water excessively dilutes the soil solution and therefore leads to an overestimation of pH by about 0.5 for most soil types. In Australia, however, soil pH1:5 is usually determined. All data shown in terraGIS has been determined using the pH1:5 methods.

Regardless of the method used, the extract is measured using a pH meter, which displays the electrical potential difference between the glass electrode containing a solution of a known pH and the test solution.

In order to determine soil pH1:5, using the electrometric method, the following steps are undertaken:

1. Place 5 grams of soil into a pop-top tube;
2. Add 25 ml of distilled water;
3. Place the sealed pop-top tube onto spinning wheel;
4. Remove pop-top tube after 20 minutes; and,
5. Measure and record soil using a pH meter.

Soil Unit Very low Low Moderate High Very High pH 8.3

When soil pH is very low to moderate, lime is commonly added since it will dissolve to form acid-neutralizing constituents (i.e. Ca2+) and also provide a source of Ca.

However, in neutral and alkaline soils, lime is very stable and will not rapidly dissolve. Adding lime in these conditions will do very little to improve nutrient availability and may even further reduce the solubility of phosphorus (P) and some micro nutrients.

Cation exchange

The “soil cations” essential for plant growth include ammonium, calcium, magnesium, and potassium. There are three additional “soil cations”, which are not essential plant elements but affect soil pH. The additional “soil cations” include sodium, aluminum and hydrogen.

Soil cations that is essential to plant growth

- Ammonium
- Calcium
- Magnesium
- Potassium

Soil cations that affect soil pH

- Sodium
- Aluminum
- Hydrogen

The major distinguishing characteristic of cations is their positive charge. Just like a magnet, a positive charge is strongly attracted to a negative charge. When soil particles have a negative charge, the particles attract and retain cations. These soils are said the have a cation exchange capacity. Although most soils are negatively charged and attract cations, some Hawaii soils are exceptions as we will see.

The “soil cations” are further divided into two categories. Ammonium, calcium, magnesium, potassium, and sodium are known as the “base cations”, while aluminum and hydrogen are known “acid cations”.

Base Cations

- Ammonium
- Calcium
- Magnesium
- Potassium

- Sodium

Unlike the other base cations, sodium is not an essential element for all plants. Soils that contain high levels of sodium can develop salinity and solidity problems.

Acid Cations

- Aluminum
- Hydrogen

The words “base” and “acid” refer to the particular cation’s influence on soil pH. As you might suspect, a soil with a lot of acid cations held by soil particles will have a low pH. In contrast, a highly alkaline soil predominately consists of base cations.

Cations in the soil compete with one another for a spot on the cation exchange capacity. However, some cations are attracted and held more strongly than other cations. In decreasing holding strength, the order with which cations are held by the soil particles follows: aluminum, hydrogen, calcium, potassium and nitrate, and sodium.

CEC values of various soil type, media, and minerals. Soils which have high amounts of organic matter and moderately weathered clays tend to have high CECs. As soils become highly weathered, the CEC of the soil decreases. Sandy soils, too, generally have lower CEC values. This is due to the lesser surface of sandy particles in comparison with clay minerals, which decreases the ability of sand particles to hold and retain nutrients.

Source: Brady and Well. 2002. Elements of the Nature and Properties of Soil. Prentice Hall, New Jersey.

Anion exchange

In the tropics, many highly weathered soils can have an anion exchange capacity. This means that the soil will attract and retain anions, rather than cations. In contrast to cations, anions are negatively charged. The anions held and retained by soil particles include phosphate, sulfate, nitrate and chlorine (in order of decreasing strength). In comparison to soils with cation exchange capacity, soils with an anion capacity have net positive charge. Soils that have an anion exchange capacity typically contain weathered kaolin minerals, iron and aluminum oxides, and amorphous

materials. Anion exchange capacity is dependent upon the pH of the soil and increases as the pH of the soil decreases.

Base Saturation

Base saturation is a measurement that indicates the relative amounts of base cations in the soil. By definition, it is the percentage of calcium, magnesium, potassium and sodium cations that make up the total cation exchange capacity. For example, a base saturation of 25 % means that 25 % of the cation exchange capacity is occupied by the base cations. If the soil does not exhibit an anion exchange capacity, the remainder 75 % of the CEC will be occupied by acid cations, such as hydrogen and aluminum. Generally, the base saturation is relatively high in moderately weathered soils that formed from basic igneous rocks, such as the basalts of Hawaii. The pH of soil increases as base saturation increases.

In contrast, highly weathered and/or acidic soils tend to have low base saturation.

Movement of nutrient from soil to root

There are three basic methods in which nutrients make contact with the root surface for plant uptake. They are root interception, mass flow, and diffusion.

- Root interception: Root interception occurs when a nutrient comes into physical contact with the root surface. As a general rule, the occurrence of root interception increases as the root surface area and mass increases, thus enabling the plant to explore a greater amount of soil. Root interception may be enhanced by mycorrhizal fungi, which colonize roots and increases root exploration into the soil. Root interception is responsible for an appreciable amount of calcium uptake, and some amounts of magnesium, zinc and manganese.

- Mass flow: Mass flow occurs when nutrients are transported to the surface of roots by the movement of water in the soil (i.e. percolation, transpiration, or evaporation). The rate of water flow governs the amount of nutrients that are transported to the root surface. Therefore, mass flow decreases are soil water decreases. Most of the nitrogen, calcium, magnesium, sulfur, copper, boron, manganese and molybdenum move to the root by mass flow.

- Diffusion: Diffusion is the movement of a particular nutrient along a concentration gradient. When there is a difference in concentration of a particular nutrient within the soil solution, the nutrient will move from an area of higher concentration to an area of lower concentration. You may have observed the phenomenon of diffusion when adding sugar to water. As the sugar dissolves, it moves through parts of the water with lower sugar concentration until it is evenly distributed, or uniformly concentrated. Diffusion delivers appreciable amounts of phosphorus, potassium, zinc, and iron to the root surface. Diffusion is a relatively slow process compared to the mass flow of nutrients with water movement toward the root.

Nutrient Uptake into the root and plant cells

Before both water and nutrients are incorporated into plants, both must first be absorbed by plant roots.

Uptake of water and nutrients by roots

- Root hairs, along with the rest of the root surface, are the major sites of water and nutrient uptake.
- Water moves into the root through osmosis and capillary action.
- Soil water contains dissolved particles, such as plant nutrients. These dissolved particles within soil water are referred to as solute. Osmosis is the movement of soil water from areas of low solute concentration to areas of high solute concentration. Osmosis is essentially the diffusion of soil water.
- Capillary action results from water's adhesive (attraction to solid surfaces) and cohesion (attraction to other water molecules). Capillary action enables water to move upwards, against the force of gravity, into the plant water from the surrounding soil.
- Nutrient ions move into the plant root by diffusion and cation exchange.

- Diffusion is the movement of ions along a high to low concentration gradient.

- Cation ion exchange occurs when nutrient cations are attracted to charged surface of cells within the root, called cortex cells. When cation exchange occurs, the plant root releases a hydrogen ion. Thus, cation exchange in the root causes the pH of the immediately surrounding soil to decrease.

- Once water and nutrient ions enter the plant root, they move though spaces that exist within the root tissue between neighboring cells.

- Water and nutrients are then transported into the xylem, which conducts water and nutrients to all parts of the plant.

Once water and nutrients enter the xylem, both can be transported to other parts in the plant where the water and nutrients are needed. The basic outline of how nutrient ions are absorbed by plant cells follows.

Absorption of nutrients into plant cells

- Plant cells contain barriers (plasma membrane and tonoplast) that selectively regulate the movement of water and nutrients into and out of the cell. These cell barriers are:

- Permeable to oxygen, carbon dioxide, as well as certain compounds.

- Semi-permeable to water.

- Selectively permeable to inorganic ions and organic compounds, such as amino acids and sugars.

- Nutrient ions may move across these barriers actively or passively

- Passive transport is the diffusion of an ion along a concentration gradient. When the interior of the cell has a lower concentration of a specific nutrient than the outside of the cell, the nutrient can diffuse into the cell. This type of transport requires no energy.

- Active transport is the movement of a nutrient ion into the cell that occurs against a concentration gradient. Unlike passive transport, this type of movement requires energy.

AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

THEME 5.0: AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

Environmental degradation

Environmental degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable. As indicated by the I=PAT equation, environmental impact (I) or degradation is caused by the combination of an already very large and increasing human population (P), continually increasing economic growth or per capita affluence (A), and the application of resource depleting and polluting technology (T).

Environmental degradation is one of the ten threats officially cautioned by the High-level Panel on Threats, Challenges and Change of the United Nations. The United Nations International Strategy for Disaster Reduction defines environmental degradation as "The reduction of the capacity of the environment to meet social and ecological objectives, and needs". Environmental degradation is of many types. When natural habitats are destroyed or natural resources are depleted, the environment is degraded. Efforts to counteract this problem include environmental protection and environmental resources management.

Water degradation

One major component of environmental degradation is the depletion of the resource of fresh water on Earth. Approximately only 2.5% of all of the water on Earth is fresh water, with the rest being salt water. 69% of the fresh water is frozen in ice caps located on Antarctica and

Greenland, so only 30% of the 2.5% of fresh water is available for consumption. Fresh water is an exceptionally important resource, since life on Earth is ultimately dependent on it. Water transports nutrients and chemicals within the biosphere to all forms of life, sustain both plants and animals, and mould the surface of the Earth with transportation and deposition of materials.

The current top three uses of fresh water account for 95% of its consumption; approximately 85% is used for irrigation of farmland, golf courses, and parks, 6% is used for domestic purposes such

as indoor bathing uses and outdoor garden and lawn use, and 4% is used for industrial purposes such as processing, washing, and cooling in manufacturing centers. It is estimated that one in three people over the entire globe are already facing water shortages, almost one-fifth of the world's population live in areas of physical water scarcity, and almost one quarter of the world's population live in a developing country that lacks the necessary infrastructure to use water from available rivers and aquifers. Water scarcity is an increasing problem due to many foreseen issues in the future, including population growth, increased urbanization, higher standards of living, and climate change.

Climate change and temperature

Climate change affects the Earth's water supply in a large number of ways. It is predicted that the mean global temperature will rise in the coming years due to a number of forces affecting the climate, the amount of atmospheric CO2 will rise, and both of these will influence water resources; evaporation depends strongly on temperature and moisture availability, which can ultimately affect the amount of water available to replenish groundwater supplies.

Transpiration from plants can be affected by a rise in atmospheric CO2, which can decrease their use of water, but can also raise their use of water from possible increases of leaf area. Temperature increase can decrease the length of the snow season in the winter and increase the intensity of snowmelt in warmer seasons, leading to peak runoff of snowmelt earlier in the season, affecting soil moisture, flood and drought risks, and storage capacities depending on the area.

Warmer winter temperatures cause a decrease in snow pack, which can result in diminished water resources during summer. This is especially important at mid-latitudes and in mountain regions that depend on glacial runoff to replenish their river systems and groundwater supplies, making these areas increasingly vulnerable to water shortages over time; an increase in temperature will initially result in a rapid rise in water melting from glaciers in the summer, followed by a retreat in glaciers and a decrease in the melt and consequently the water supply every year as the size of these glaciers get smaller and smaller.

Thermal expansion of water and increased melting of oceanic glaciers from an increase in temperature gives way to a rise in sea level, which can affect the fresh water supply of coastal areas as well; as river mouths and deltas with higher salinity get pushed further inland, an intrusion of saltwater results in an increase of salinity in reservoirs and aquifers. Sea-level rise may also consequently be caused by a depletion of groundwater, as climate change can affect the hydrologic

cycle in a number of ways. Uneven distributions of increased temperatures and increased precipitation around the globe results in water surpluses and deficits, but a global decrease in groundwater suggests a rise in sea level, even after melt water and thermal expansion were accounted for, which can provide a positive feedback to the problems sea-level rise causes to fresh-water supply.

A rise in air temperature results in a rise in water temperature, which is also very significant in water degradation, as the water would become more susceptible to bacterial growth. An increase in water temperature can also affect ecosystems greatly because of a species' sensitivity to temperature, and also by inducing changes in a body of water's self-purification system from decreased amounts of dissolved oxygen in the water due to rises in temperature.

Causes of Environmental Degradation

The primary cause of environmental degradation is human disturbance. The degree of the environmental impact varies with the cause, the habitat, and the plants and animals that inhabit it.

Habitat Fragmentation

Habitat fragmentation carries long term environmental impacts, some of which can destroy entire ecosystems. An ecosystem is a distinct unit and includes all the living and non-living elements that reside within it. Plants and animals are obvious members, but it will also include other components on which they rely on such as streams, lakes, and soils.

Habitats become fragmented when development breaks up solid stretches of land. Examples include roads which may cut through forests or even trails which wind through prairies. While it may not sound all bad on the surface, there are serious consequences. The largest of these consequences are initially felt by specific plant and animal communities, most of which are specialized for their bioregion or require large areas of land to retain a healthy genetic heritage.

Area Sensitive Animals

Some wildlife species require large stretches of land in order to meet all of their needs for food, habitat, and other resources. These animals are called area sensitive. When the environment is

fragmented, the large patches of habitat no longer exist. It becomes more difficult for the wildlife to get the resources they to survive, possibly becoming threatened or endangered. The environment suffers without the animals that play their role in the food web.

Aggressive Plant Life

A more critical result of habitat fragmentation is land disturbance. Many weedy plant species, such as garlic mustard and purple loosestrife, are both opportunistic and invasive. A breach in the habitat gives them an opportunity to take hold. These aggressive plants can take over an environment, displacing the native flora. The result is habitat with a single dominant plant which doesn't provide adequate food resources for all the wildlife. Entire ecosystems are threatened with extinction, according to the National Resources Defense Council.

Some weeds are so invasive and aggressive that they are declared noxious by the federal or state governments to prevent them from destroying unspoiled areas. The cultivation or even the sale of noxious weeds is prohibited by law.

Human Sources of Environmental Deterioration

Humans and their activities are a major source of environmental degradation.

Water and Air Pollution

Water and air pollution are unfortunately the common causes of environmental degradation. Pollution introduces contaminants into the environment that can maim or even kill plant and animal species. The two often go hand in hand.

Acid Rain

Acid rain occurs when sulfur dioxide from coal plant emissions combines with moisture present in the air. A chemical reaction creates this acid precipitation. Acid rain can acidify and pollute lakes and streams. It causes similar effects to the soil. According to the U.S. Environmental Protection Agency (EPA), if enough acid rain falls in a given environment, it can acidify the water or soil to a point where no life can be sustained. Plants die off. The animals that depend upon them disappear. The condition of the environment deteriorates.

Agricultural Runoff

Farming creates agriculture runoff issues.

Agricultural runoff is a deadly source of pollutants which can degrade environments, so much so that the EPA identifies agriculture as the primary source of water pollution.

Surface water washes over the soil and into lakes and streams. When it does so, it carries the fertilizers and pesticides used on the farm lands into water resources. Introducing poisons into waterways will have dire consequences. Fertilizers, whether or not they are organic, carry equal risks.

Fertilizers containing large amounts of phosphorus can cause explosions of algae in lakes. As the algae die, bacteria start to breakdown the organic material. It soon develops into a situation where bacteria are using up the available dissolved oxygen in the water. Plants, fish, and other organisms

begin to die off. The water becomes acidic. Like acid rain, lakes become dead zones with conditions so toxic that neither plants nor animals can live in these environments.

Urban Development

According to many noted ecologists, including those at Cornell University, urban development is one of the primary causes of environmental degradation. As populations increased, so did the need for land for homes and farms. Wetlands were drained. Prairies were plowed over. Today, less than 50 percent of the nation's wetlands still exist, according to the North Carolina State University Water Quality Group. National Geographic states that only five percent of the native prairie remains.

Environmental degradation is one of most urgent of environmental issues. Depending upon the damage, some environments may never recover. The plants and animals that inhabited these places will be lost forever. In order to reduce any future impacts, city planners, industry, and resource managers must consider the long term effects of development on the environment. With sound planning, future environmental degradation can be prevented.

Environmental issues can be seen by long term ecological effects, some of which can demo lish whole environments. An environment is a unique unit and incorporates all the living and non-living components that live inside it. Plants and creatures are evident parts of the environment, but it also includes the things on which they depend on, for example, streams, lakes, and soils.

Environmental surroundings get to be divided when technological advancement splits up areas of land. Some examples of this can include streets which may slice through woods or even trails which wind through prairies. While it may not sound all terrible on the surface, there are bad results. The biggest of these results are felt by particular animal and plant groups, the vast majority of which are specific for their bio-region or need a large area in order to make sure that their genetic lines are kept intact.

Natural Causes

Mother Nature causes environmental problems, too.

While environmental degradation is most commonly associated with the activities of humans, the fact is that environments are also constantly changing over time. With or without the impact of human activities, some ecosystems degrade over time to the point where they cannot support the life that is "meant" to live there.

Things like landslides, earthquakes, tsunamis, hurricanes, and wildfires can completely decimate local plant and animal communities to the point where they can no longer function. This can either come about through physical destruction via natural disaster or by the long-term degradation of resources by the introduction of an invasive alien species to a new habitat. The latter often occurs after hurricanes, when lizards and insects are washed across small stretches of water to foreign environments. Sometimes, the environment cannot keep up with the new species, and degradation can occur.

Causes of Environmental Degradation

Some environmental life species require substantial areas to help provide food, living space, and other different assets. These creatures are called area specific. At the point when the biome is divided, the vast patches of living space don’t exist anymore. It gets to be more troublesome for the wildlife to get the assets they need in order to survive. The environment goes on, even though the animals and plant life are not there to help sustain it properly.

1. Land Disturbance: A more basic cause of environmental degradation is land damage. Numerous weedy plant species, for example, garlic mustard, are both foreign and obtrusive. A rupture in the environmental surroundings provides for them a chance to start growing and spreading. These plants can assume control over nature, eliminating the local greenery. The result is territory with a solitary predominant plant which doesnâ€Ÿt give satisfactory food assets to all the environmental life. Whole environments can be destroyed because of these invasive species.

2. Pollution: Pollution, in whatever form, whether it is air, water, land or noise is harmful for the environment. Air pollution pollutes the air that we breathe which causes health issues. Water pollution degrades the quality of water that we use for drinking purposes. Land pollution results in degradation of earth’s surface as a result of human activities. Noise pollution can cause irreparable damage to our ears when exposed to

continuous large sounds like honking of vehicles on a busy road or machines producing large noise in a factory or a mill.

3. Overpopulation: Rapid population growth puts strain on natural resources which results in degradation of our environment. Mortality rate has gone down due to better a medical facility which has resulted in increased lifespan. More population simple means more demand for food, clothes and shelter. You need more space to grow food and provide homes to millions of people. This results in deforestation which is another factor of environmental degradation.
