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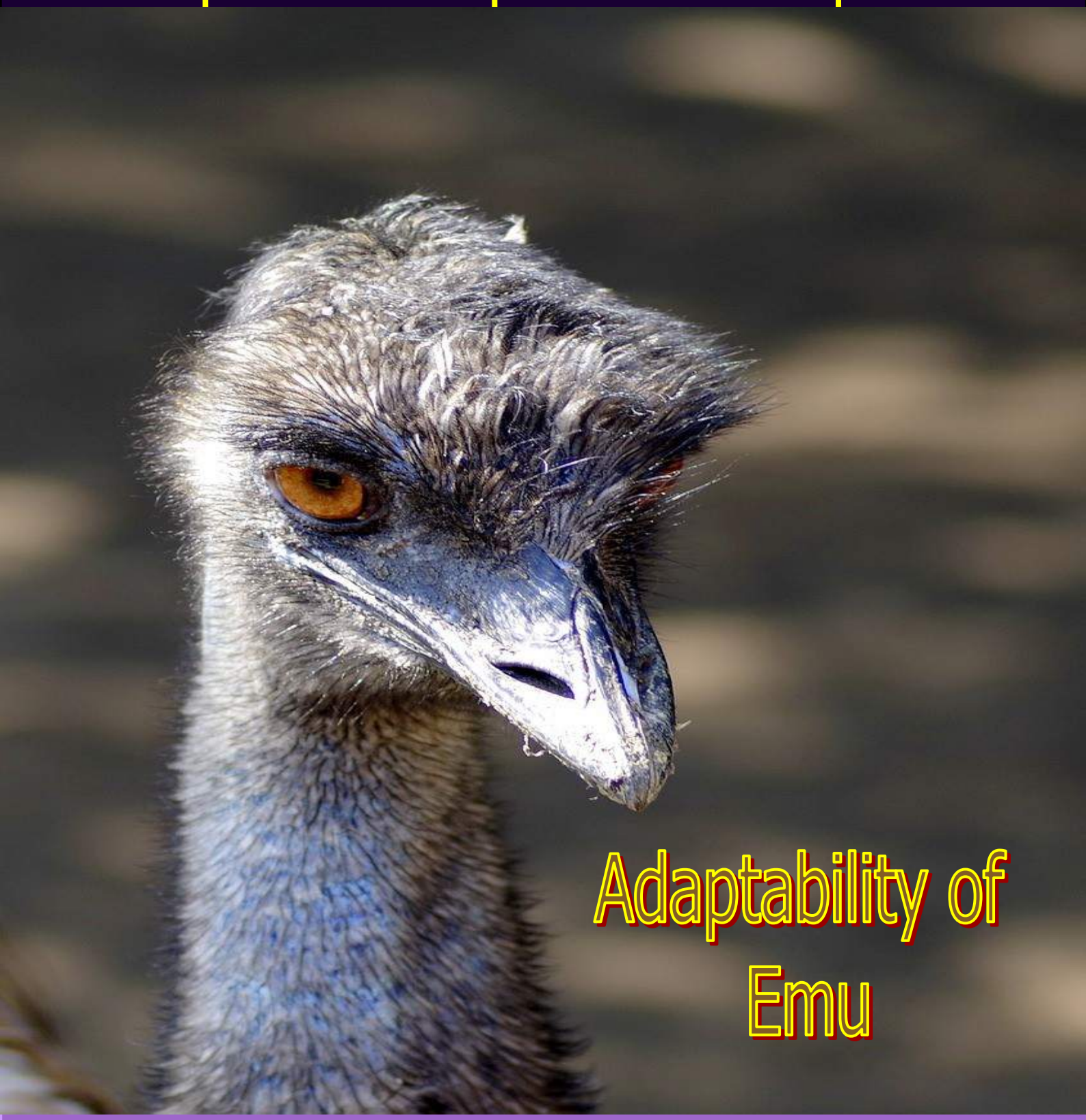

Adaptability of Emu

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Types of greenhouse and low cost models in agriculture

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GREENHOUSE

It is a framed structure in which plants are grown under protected condition and should be large enough to do cultural operations inside. In a greenhouse, environment can be controlled according to need of the crop.Material used in construction of greenhouses may be iron, aluminium, wood, bamboo, etc.Framed structure is covered with different types of covering materials like polyethylene, PVC, fiber glass, polycarbonate, *etc*.

- A greenhouse covered with polythene is called **polyhouse**, which is about ten times cheaper than that of glass material called as **glasshouse**.

Types of Greenhouse

1. Based on shape

a) Lean-to-type greenhouse
b) Even span type greenhouse
c) Uneven span type greenhouse
d) Ridge and furrow type
e) Saw tooth type
f) Quonset type greenhouse
g) Gable roof or standard peak type greenhouse

a) Lean-to-Type

- This type of design is used when a greenhouse is constructed against south side of an existing building and roof of greenhouse slopes south.
- A door is usually placed along one of the shorter sides.
- Roof is sloping, either sharply angled or rounded.
- Plants can make best use of sunlight.
- Minimizes the requirement of the roof support.
- Cost of construction of another side of the greenhouse wall reduces.

b) Even span type

- They are designed on leveled ground.

- There are two slopes on both the sides of greenhouse.
- Roofs of these types of greenhouses are of equal length on both the sides.

c) Uneven span type

- This type of green house is constructed on sloppy land.
- Uneven span greenhouses are just like regular greenhouses, only the difference is that the structure of the uneven span greenhouses are unequal, whereas with the regular greenhouses all of the widths and heights are typically exactly equal. One side of the roof is longer than the other side and in some cases shorter roof may be absent.
- These are used to increase natural cooling especially in hilly or in some windy areas. These types allow more amount of light to enter in during low light condition of winter.

d) Ridge and Furrow type Greenhouse

- These are 'A' designed greenhouses which are connected to one another along the length of the eave. The eave serves as a furrow or gutter to carry rain and melted snow away.
- The side wall is eliminated between the greenhouses which results in a structure with a single larger interior.
- This design reduces labour cost of automation, improves personnel management and reduces fuel consumption because it has less exposed wall area through which heat escapes.

e) Saw Tooth Type

- It is a very strong greenhouse type. Roof ventilation covers 25% to 40% of ground area.
- Suitable for flowers and vegetables.
- This structure is similar to ridge and furrow type greenhouse except that there is a provision for natural ventilation.

f) Quonset

- This kind of greenhouse is constructed by using pipe arches or trusses for support.
- These are connected either in free standing style or arranged in an interlocking ridge and furrow.
- Shape- semi round extended to ground. Sidewalls can also be present.
- Tops and sides should be covered with polythene or fiberglass.

g) Gable roof or standard peak

- The roof of this type of greenhouse is triangular in shape.
- It is most suitable for temperate region where the roof has to take considerable amount of snow load.

2. Greenhouse types based on Utility

Classification can be made depending on the functions or utilities. Of the different utilities, artificial cooling and heating are more expensive and elaborate. Hence based on this, they are classified into two types, which are:

a) Greenhouses for active heating
b) Greenhouses for active cooling

a) Greenhouse for Active Heating

- In winter, air temperature inside greenhouse decreases during night time, therefore, to avoid the cold bite to plants (freezing) some amount of artificial heat has to be supplied.
- Achieved by using double layer polyethylene, thermo-pane glasses and heating systems like Unit heaters, central heat, radiant heat and solar heating system.

b) Greenhouse for Active Cooling

- In summer for plant survival it is necessary to reduce inside temperature of greenhouse for effective crop growth
- Achieved by evaporative cooling or fan and cooling system, fog cooling, roof shading, double layer of glazing, etc.

3. Greenhouse type based on construction

The type of construction predominantly is influenced by structural material, though the covering material also influences the type. Higher the span, stronger should be the material and more structural members are used to make sturdy tissues. So based on construction, greenhouses can be classified as:

a) Wooden framed structure
b) Pipe framed structure
c) Truss framed structure

a) Wooden framed structures

This kind of greenhouse is made with less than 6 m height and only wooden frame is used here. Side post and columns are constructed of pinewood without the use of a truss.

b) Pipe framed structures

This kind of greenhouse is made when the greenhouse span is less than or equal to 15 m. Basic structure of such greenhouses is made up of pipes.

c) Truss framed structure

- If greenhouse span is greater than or equal to 15 m, truss frames are used. Flat steel, tubular steel or angular iron is welded together to form a truss encompassing rafters, chords and struts.
- A **truss** is a structure that "consists of two-force members only, where the members are organized so that the assemblage as a whole behaves as a single object. A "two-force member" is a structural component where force is applied to only two points. The top beams in a truss are called *top chords* and are typically

in compression, the bottom beams are called *bottom chords*, and are typically in tension.

- **Struts** are support members under compression and **chords** are support members under tension. Angle iron purlins running throughout the length of greenhouse are bolted to each truss.A**rafter** is one of a series of sloped structural members that extend from the ridge or hip to the wall plate, downslope perimeter or eave, and that are designed to support the roof deck and its associated loads.

4. Greenhouse type based on covering material

Covering materials are the important component of the greenhouse structure. They have direct influence on greenhouse effect, inside the structure and they alter the air temperature inside. The types of frames and method of fixing also varies with covering material. Hence, based on the type of covering material used, they may be classified as:

a) Glass glazing

b) Fiber glass reinforced plastic (FRP) glazing

i. Plain sheet

ii. Corrugated sheet

c) Plastic film

i. UV stabilized LDPE film

ii. Silpaulin type sheet

d) Number of glazings

i. Single

ii. Double

e) Based on the cost of construction involved (which includes various factors mentioned from a to d)

i. High cost Green House

ii. Medium cost Green House

iii. Low cost Green House

a) Glass glazing greenhouse

- Glass has higher light transmission and durability over other cladding material. Due to heavy weight and massive frame work, the initial cost is more but due to its long lasting life, it is cheaper compared to frequent replacing plastic/polythene films.
- A good foundation is required and the frames must be strong and must fit well together to support heavy, rigid glass.

b) Fiber glass reinforced plastic (FRP) glazing

- **Fiber reinforced plastic** (**FRP**) (also *fiber-reinforced polymer*) is a composite material made of a polymer matrix reinforced with fibers. The fibers are usually glass, carbon, basalt or aramid, although other fibers such as paper or wood or asbestos have been sometimes used.
- PVC rigid panels, fiber glass–reinforced plastic, acrylic and poly carbonate rigid panels are used as covering material.

- Resistant to breakage and light intensity is uniform.

c) Plastic film greenhouses

- These kinds of greenhouses are covered with flexible plastic films like polyethylene, polyester and PVC.
- Generally, these are replaced more frequently than other covers. Structural costs are very low because the frame can be lighter and plastic film is inexpensive. Light transmission of these film-plastic coverings is comparable to glass.
- Low density polyethylene is popular and commonly used due to easy covering, low cost, minimum frame work cost and saves 40% heat compared to glass or FRP greenhouses.
- UV rays of sunlight have serious effect on the life of polyethylene film, therefore, UV stabilization system is incorporated at the time of manufacturing (UV stabilized LDPE film).

e) Based on the cost of construction

1.Low cost or low tech

- greenhouse without fan and pad (Rs. 300 - 500/m^2)

2. Medium cost or medium tech

- greenhouse with pad and fan system without automation (Rs. 800 - 1100/m^2)

3. High cost or hi-tech greenhouses with fully automatic control system = Rs. 2000-3500/m^2

Low cost models are:

a) Use of plastic mulches

- Plastic mulches are mainly used for weed control, to increase soil temperature and to keep soil moist resulting in reduction in the use of irrigation water. Most preferred mulch are transparent (clear) and black, although wide variety of shades and colors are being used for specific purpose.
- Double plastic mulches are also used.

b) Plastic low tunnels – These are temporary structures erected over the individual rows of the beds by stretching transparent plastic only to protect the crops against extreme low temperature during winter season for their advancement of 25-30 day over normal season of sowing under open fields.

- Can be used for off season production of vegetables mainly cucurbits.
- Optimum size is 45 x 60 cm width and height depending upon crop and planting time.
- Plastic film of 20-25 micron thickness stretched over bent GI of 8 mm diameter.

c) Walk-in-tunnels: These are purely the temporary structures which are made by using GI pipes and transparent plastic of 180-200 micron thickness. They are used for complete off-season cultivation of vegetables like bottle gourd, cucumber, tomato, etc. during winter season (Dec-Jan).

- **Objective and utility**- To fetch high price of the off season produce to earn more profit per unit area.
- **Optimum size**- 100-120 sq. m, having 4 m width and 25 to 30 m length with 2 m central height.

d) High tunnels with top ventilation- These are permanent structures which can be prefabricated and assembled on site by means of bolts, nuts and washers only. Such structures are made with galvanized steel pipes and profiles for long life of the structure.

- Such structures are provided with 1 m of top ventilation along with a central height of 4.7-5.0 m and side ventilation of 2.2-2.5 m.

e) Insect proof net house- It can be fabricated as temporary and permanent structures. Temporary structures can be fabricated in walk-in-tunnel design and shape with double door facility at one end of the structure.

- Permanent structures can be fabricated in two designs, one as flat roof design and shape with a height of 2.5-3.0 m, while, other can be fabricated in dome shape in greenhouse design.
- Insect proof net used- 40 or 50 meshes.
- **Objective**- used to protect the crop from insect attack.

f) Shade net house- These are low cost, temporary to semi-permanent structures made by providing 40-60% shade as per crop schedules and requirements.

- Optimized size is 100-120 m^2 and height of the permanent shade net house is 2.5-3.0 m.
- **Basic objective**- to reduce the temperature and radiation for successful cultivation of crops like green coriander, beet leaf, etc.
- Basic cost of fabrication of such shade net is approx. Rs. 100-120/sq. m.

g) Zero energy naturally ventilated green/polyhouse- It is the protected structure where no heating or cooling devices are provided for climate control. These are simple and medium cost greenhouses which can be fabricated with a cost of approx. Rs. 700-850/ sq. m.

- These structures have manually operated cross ventilation system for use as and when required.

Adaptability of Emus in Indian Tropics

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ABSTRACT:
Emu (*Dromiusnoveahollandiae*) is the second largest flightless bird after the ostrich under the group ratiteslike kiwi, ostrich and rhea.The name ratite comes from birds with flat breastbone that looks like a raft and mostlycartilaginous plate. Emu farming can enhance the agro-business beneficial contribution to the human race through pain relieving oil, redhealthy meat, soft and flexible leather and very attractive feathers. Emu was originated from Australia and spreadall over the world like U.S.A, China and Australia including Asian countries. Emu is famous for 98% fat free red meat and other products such as emu oil, skin, feathers and ornamental eggsand toesare used commercially.

Keywords: Emu, Flightless bird, Ratites, Meat, Fat free meat

INTRODUCTION

Commercially emu IS reared in many parts ofthe world for their meat, oil, skin and feathers and theseare of high economic value in the market(Patel *et al*., 2015). Emu farming is popular for its fast growing rate and adaptswide range of atmospheric conditions. On contemporary, their adaptability features and future demand of emu's products, the species had been introduced in India since 90s (Rao, 2004). The birds can be raised on high fibrous diet under extensive as well as semi intensive rearing systems. The various products are obtained from emu like meat, egg, skin, toe and feather. Emu meat has low fat which is beneficial to human being suffering from cardiovascular disease. Emu oil has medicinal, wound healing and anti-inflammatory properties. Emu skin is used for preparation ofvarious items like shoes and bags. Emu eyes are used to replace the damaged cornea of human being. Key chain and pendants in necklaces are made by use of nails of emu.Pillows and other fancy products are produced by use of emu feathers.Emu eggs are green in colour and about ten times larger than hen eggsand contain equal volume of yolk and albumin (Koga, 1969). Emus are usually solitary birdshowever, they alsotravels in pair. When large amount of feed is available they

move towards feed in flocks. Emu is fast running bird and can run upto 30 miles / hours. They are also excellent swimmers.

External appearance

The emus are dissimilar from chicken.They have under developed wings withlong and strong legs and absence of comb, wattles, tail and wing feathers. Average height of the adult is recorded as 5 – 6 feetwith body weight about 40-50 kg. Emu'scan't fly but they can run very fast. Emu chicks have body stripes similar to squirrel and later changes into brown colour after three months. Three toes in each leg covered with scaly skin might be thereason for emu'sadaptivity in hardy and dry soil. Its entire bodyis covered by long feathers except on the neck. The feathers of male aredifferent from female. The female isusually larger than male like Japanese quail. She selects a mate and defends a territory for the nest. The male emu has peculiar character that sit on nest for incubating eggs. Emu beaksare smaller in size but more flat in comparision to chicken. Mature emu has bare blue neck with crescent shaped behind the eye.The lifespan of emu is recordedup to 35 years (Waraleet *al*.,2014).

Chick management

Emu chick hatches naturally and/or by using incubator. Artificial incubation is often conducted at atemperature of approximately 97.5^0F. Chick born with coffee brown colour with white line marks which changes after 3months. Reproducing chicks can be repeated with an adult pair of Emu's for minimum 25 times (25-40 eggs everyyear). Emu chicks weigh approximately 370 to 450g. Emu chicks are restricted to hatcher for first 2-3days for the proper absorption and drying of egg yolk. There is needfor proper cleaning and disinfection of brooding shed with floor covered with gunny bag for the prevention of the leg abnormality due to slipping at growing stage. Emu chicks are more susceptible to incurable hip dislocation because of its long legs. Each brooder having 25 to 40 chicks, providesspaceof foursq.ft./chick for first three weeks. The optimum brooding temperature is90^oF for the first week and 85^oF till three tofour weeks of age. Feed and water alongwith brooder guard of 2.5ft. heightwith feed starter mash is required for first 8 weeks. To persist healthy life of emu, sufficient running space is needed with optimum floor spaceof 40ft. x 30ft. (40 chicks with open space) (Patel *et al*., 2015).

Grower management (9 to 42 weeks of age)

During growing stage they require larger size of waterers with feeders and increased floor space for stand or run.At this stage grower mash should be provided upto 42 weeks of age with 10% greens (carrot, papaya and cucumber) maybe offered. Dewormingis done once with broad spectrum anthelmintic/ivermectin and vaccination is done with R2B at 8^{th}week of age and repeated at 40^{th}week of age against ranikhet disease. Provision of 40ft. x 100 ft. space is sufficient for 40 birds.

Sex differentiation

Externally emu's look identically in both sexes. Hence, sexing is done on day old chick based on feathersexing, identifying male organ and sound differentiation on maturity by vent sexing. However, male emu after attaining sexualmaturity produces grunting sound, whereas female produces drumming sound.

Reproduction

Emu reaches sexual maturity at 1.5 to 3 years of ageand breeding starts in the month of October to February in India. Males and females are generally paired in a ratio of 1:1 and in some case polygamous mating (more than one female per male) has been observed. Emu usually lays eggs at evening between 5: 00 to 7: 00 p.m. Courtship consists of series of strutting and displaying the neck feathers by both the female and male. Feed intake is reduced upto 50 percent during breeding. The female produces a drumming sound called booming and the male produces a grunting sound called growling. Emu is allowed to pair naturally from a communal pen or across fences and then are moved to a breeder pen together. Non-compatible birds fight among themselves. Many emuslay eggsin their second year of age. They lay eggs in the winter months, mostly in month between November and March. Three – fourdays are required to lay one egg with an average of 30 - 40 eggs laid per season. Some emus may produce up to 50 eggs per season.

Shelter Management

Shelter is required to protect adult and young emu from adverse weather conditions i.e. extremecold or hot. For better management emuchicks (370 to 450 g) are restricted to incubator up to 48hours or 2 days for proper drying and quick absorption of theyolk. In artificial brooding, 25-40 chicks are kept at4 ft^2 space per chick upto 3 weeks of age. To prevent fromjumping and wonder off of chicks, 2.5 feet high chickguard is recommended. 40 watt bulb for every 100 ft^2 area isrequiredfor maintaining optimum temperature, inside the brooder.Growing emus require optimum body weight of 40 kg at the time of marketing for meatpurpose. Grower ration is continued up to18-24 weeks of age by phase feeding in layer emu. One pair breeding emu can be housed in a shelter minimum 100 x 25 feet area covered from top and on two orthree sides wall. Pens should be separated by fence 5 to 6 feet height, to provide safemovements / locomotion of birds. In case of colony pen, space is provided with100ft x 100ft for 4 breeding pairs of emu. Diet of breeding emu should be fortified with minerals and vitamins and is given in advance i.e. 3-4 weeks prior tobreeding season to ensure better fertility andhatchability. Separation of both sexes after breedingseason is a good commercial practice. Normally an adult emuconsumes 1 kg feed /day but during breeding seasonfeed intake will be subsequently decreased.

Incubation and Hatching

Emu egg isemerald green in colour with weight about 600 to 800 g. The optimum incubation period in emuvaries from 46 to 52 days. Eggs are collected daily and are stored in a cooler at temperature of 60^oF for maximum seven days. Best hatchability is made by optimumhatchery conditions like holding, duration and temperaturebefore

setting the eggs. In common habitat they reduces up to 1/3rd of their body weight because they sitson eggs till hatches come out during which they stop eating and drinking. In case of artificial condition hatching eggs should be cold stored at 65 to70^{o}F with rotation of two times daily before setting tomaintain optimum hatchability. Temperature ofincubation is 97-98.4^{o}F (dry bulb) withrelative humidity of 20-30% (67-73^{o}F wet bulb) andincreases the relative humidity to 30-40% after the hatchfor better drying (Davis, 2005). Emu embryo'susually takes 2-3 times longer incubation time in comparison to chicken stage (Nagai *et al*., 2012).The developing embryo'sproduces carbon dioxide and water as the by-products ofmetabolism by using expense of yolk lipids andalbumen proteins which leads eggstoloose weight throughout the incubation atthe rate of 1.5 g/day. Emu chicks weigh approximately 370 to 450 g (approximately 67% of total egg weight). Emu chicks hatch out on 52ndday naturally and assisted hatch is also carried out manually byhelping the chick to come out by opening the shell at the head and toe positions. The normal hatchability is approximately 70%.

Identification

Identification is importantformaintaining record keeping and protection against theft. Microchip identification systems are commonly used. Microchips are inserted in the pipping muscle just behind the head with an implant gun and needle during hatching time. Microchip reader is a device that reads the code embedded in microchip. Each label of microchiprequires its own reader.Leg bands are used with different colorsfor identification and are placed throughout ankle. Tattooing used as a permanent identification also has been used successfully, but does require a certain skill(Jensen *et al.,*1992).

Nutrition

Emu requires balanced diet for their optimum growthand reproduction and feeding contributes 60-70% of thetotal emu farming cost. An adult emu eats around 1.4 to1.5 kg feed/day. Emu favours pellets or mash type offeed under different stages:

- Chick starter – 0 day to 2 to 3 months of age
- Grower – up to 8 months of age after chickstarter until breeder ration
- Finisher – Till market as meat bird from 14 to 16months of age.
- Breeder – From 16 months onwards untilcompletion of lay.
- Maintenance – after completion of laying till fewmonths before the next season of laying.

Emus are omnivorous in nature and feed on a wide range of plants as well as insects. Thegastrointestinal tract of emu consists of relatively larger small intestine and short large intestine leading todigesta retention in less time.Emusare able to digest a little portion of theingested fiber and digestibility ranges from 0 to 45% (Bennett *et al*.,2013). The FCR of emu is 6:1 and methonine is first limiting amino acid which is deficient in cereal and forage. It is supplemented synthetically because it requires for feather growth. Emusare excellent foragers in nature andpass their life on available fruits, vegetables, andinsect's (red clover, papaya, caterpillars,grasshopper etc). Chicks can pick up foodat the 4th day of age from the ground surface. The grower kept for breeding

purpose isrequiredtobe fed on maintenance ration from 8 months to sexual maturity by 18-24months of age (Jefferey, 2001).In commercial farms, feeds areformulated as starter, grower, finisher, breeder etc. asper requirement (Table.1).

Table 1: Nutrient requirements suggested for Emu

Parameters	Starter	Grower	Finisher	Breeder	Maintenance
ME (kcal/kg)	2700	2600	2600	2600	2400
Crude Protein (%)	20	18	16	20	15
Crude Fiber (%)	9	10	10	10	10
Lysine (%)	1	0.80	0.70	0.90	0.63
Methionine (%)	0.45	0.40	0.35	0.40	0.25
Tryptophan (%)	0.17	0.15	0.13	0.18	0.12
Threonine (%)	0.50	0.48	0.42	0.60	0.38

Healthcare Management

Though emus are sturdy, health problemsare observed in chicks and growing stages. Emus aresusceptible to various diseases like encephalomyelitis,salmonellosis, clostridiosis, aspergillosis, etc. They are also more susceptible to internaland external parasitic infestations like coccidiosis,ascaridiosis and lice (Davis, 2005).The drug of choice to preventexternal and internal worms isivermectin at 1 month of age and repeat in one month interval(Jeffery, 2001). It is reported thateastern equine encephalomyelitis (EEE) is the most fatalviral disease in emu (Jefferey, 2001).For ranikhet disease,vaccination at the age of 1 and 4 weeks (Lasota strain) and8, 15 and 40 weeks (Mukteshwarstrain) provides betterimmunity in India to prevent outbreak of the disease. Ivermectin given at 1 month of age is used to prevent nematode infestations. Carbaryldust (5 percent powder) is also used by the USDA at 14-day intervals to treat tick infestations in emu.

Emu product

The products prepared from emu are discussed as under:

1. **Meat:** Emu meat with low fat,cholesterol and gamey flavor is renamed as "newheart healthy". Emu meat which is tender and delicious is suitable for consumption of all age of human being as compared to meat of other livestock. Emu meat is 98% free from fat (Table. 2). It has medicinal value; meat is suitable for person suffers from cardiovascular diseases.Considering textureand taste, emu meat has 10 times less saturated fatty acid in comparison to beef meat. It is excellentsource of minerals, protein, iron and vitamin C. Emu meat has higher protein andash content but lower fat, total lipids and cholesterolcontent than meat of other species (Naveena*etal.,* 2013).

Table. 2: Composition of meat in different species

Analysis	Ostrich	Emu	Deer	Pork	Beef	Poultry	Fish
Water (%)	75.4	73.6	74.5-75.1	70	75	73-75	82
Fat (%)	1-2	1.7-4.5	3.3	25	2-16.3	1-3.6	1

Protein (%)	22	21	20.6	18-28	18-22	21-24	16
Collagen (%)	0.37	1.1-2.0	1.24	0.5	-	-	-
Iron (mg/ 100g)	3.5	-	4.5	1.1	3.0	1.2	-
Magnesium (mg/100g)	-	28.7-30.9	29	17-25	20	20-27	25-50
Phosphorus (mg/100g)	-	480-490	249	-	-	-	240-500
Potassium (mg/ 100g)	-	313.5-317	330	-	-	-	250-400
Cholesterol(mg/ 100g)	38-60	39-48	112	62-105	63-86	64-98	57
Calcium (mg/ 100g)	5.2	4.5-7.7	7	10	9-10	8.17	20-40
Energy (KJ/100g)	438	471-531	494	1335.8	657.6	478.6	397.4
Calories (Kcal/100g)	100-115	113-127	108	319.3	160-256	110-185	70-120
(Reddy, 2004 and Scheideler, 1997)							

2. **Oil:** Emu produces oil by the process of rendering of fat.It has cosmetic and medicinal values. In pure form it is clear liquid and white colour and has bacteriostatic activity (Warale 2004).It isalso nontoxic as well as non irritant. Emu oil is used in treatment of various diseases like arthritis, alopecia and burn injuries and is used as wound healing medium and reduces keloid scarring, with high permeability to skin (Patel *et al*). It is also used as analgesic as well as antiseptic and anti allergic agents. Adult emu produces 4-6 litre oil. The emu oil is composed ofmystiric acid (0.40%),palmitic acid (22%), stearic acid (9.60%), oleic acid(47.40%), linoleic (15.20%) and linolenic acid (0.90%).
3. **Emu hide:** High quality of hide with 6 - 8 square feet is obtained from the adult bird and fetches high economic price in the market.Hide is used for preparation of various products like boots, belts,luggage, and accessory items as well as wonderful medium for craft. The leg hide is very unique having scales like a crocodile hide andis used for protective product like knives and sword.
4. **Eggs: A**ll poultry eggs are nutritious as well asfavorable edible product. The emu eggs are considered as a standardfood product (Rao*et al.,* 2008).Egg is emerald green colour with approximately700-800 gweight which is equalto 10-12 chicken eggs by weight. On average, egg weight is 560 g with a constant shapeindex of 66.40. The egg contains(Table.3) 71.80%moisture, 12.90% CP, 13.80% Lipid, 0.20% carbohydratesand 1.30% total ash(Mext, 2005**)**. It is observed thatmoisture loss upto 12.30% is optimum for good hatchability of emueggs (Rao*et al.,* 2008).

Table.3: Composition of emu egg in comparison to hen egg						
Particulars	**Emu**			**Hen**		
	Whole	**Albumen**	**Yolk**	**Whole**	**Albumen**	**Yolk**

Water	71.80	89.10	55.00	76.10	88.40	48.20
Protein	12.90	8.90	14.90	12.30	10.50	16.50
Lipid	13.80	1.10	28.20	10.30	Trace	33.50
Carbohydrate	0.20	0.20	0.20	0.30	0.40	0.10
Ash	1.30	0.70	1.70	1.00	0.70	1.70

5. **Emu Feathers:** Emu feathers are attractive, soft andused for preparation of brushes.
6. **Egg Shells:** The eggs shells are painted with different colour and are used as decorative items.
7. **Toe Nails:** It is used inpolishing ofjewelry.

Economics and Marketing

Theeconomic survey of emu farming indicated that costinvolved in purchasing of expensive breeding stockandhatchery construction is 68% and 13%, respectively. Goodhatchability(more than 80%) is a major step for better returns or income from emu farming along with lower feeding cost and reducedchick mortality (less than 10%).Emufarming is an excellent and prosperous looking farming enterprise due to the expansion of globalmarkets and gaining importance of meat, skin and oil inhuman's beings (Patel*et al*., 2015).

Bio-security measures in emu farming: The bio-security measures are:

1. Farm should be located away from city and human population area.
2. The fencing should be done and proper breeding facilities will be available.
3. Proper disinfection/sanitation procedures should be adopted.
4. The quarantine sheds should be available &away from other sheds of the farm.
5. Regular disease monitoring techniques like postmortem examination of dead emu and periodic serum antibodyassay will be recommended.
6. Water source should be tested for mineral, bacterial, chemical, contamination and pathogen load.
7. The pets and other species of birds should not be reared/allowed to enter the emufarm.
8. The brooding space should be optimum.
9. Proper storage of feed to prevent from contamination like mould, insect etc.
10. There should be proper destruction of the bedding as well as dead birds.
11. The equipment should be properly disinfected with the use of disinfectants (Patel *et al*., 2015).

CONCLUSION

Emu,a flightless bird is the second largest living member of theratitae family after ostrich. It is necessary to know all aspects of the emufarming.Emu's are integral part to food chains.Theyconsume a variety of plants as well as insects and beingconsumed by the predators. The demand of emu isincreasing day by day as the species has various products with high market value.

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Micro-irrigation system: A key to water conservation

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ABSTRCT

Microirrigation is introduced primarily to save water and increase the water use efficiency in agriculture. Reduction in water consumption due to microirrigation over the surface method of irrigation varies from 30 to 70 percent and productivity gain in the range of 20 to 90 percent for different crops.

INTRODUCTION

Water is the most important and critical input in man's life especially in agriculture. The pressure for the most efficient use of water for agriculture is intensifying with the increased competition for water resources among various sectors with mushrooming population. Total global water reserves are 1.4 billion km^3, of which freshwater consists only about 2.5% of total water i.e. 35 million km^3. Groundwater and surface water, which together constitutes about 30.5% of freshwater reserves. India consists about 1,953 km^3 water, of which freshwater is 1,122 km^3 (United Nations World Water Development Report 2, 2006). Agricultural sector is the largest consumer of water. It consumes 83% of total freshwater.

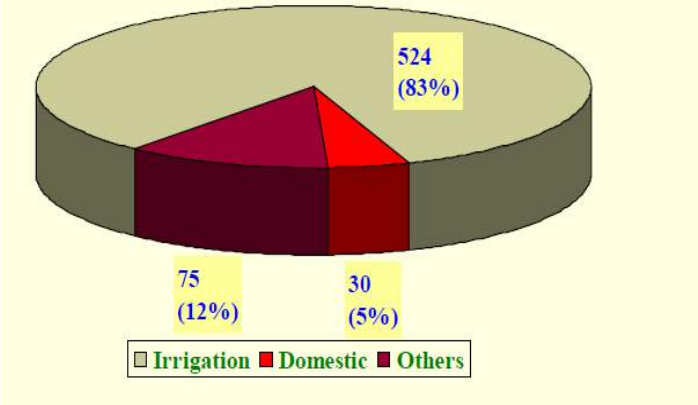

Figure 1. Water utilization by Agriculture sectors (BCM)

The overall efficiency of the flood irrigation system ranged between 25 to 40 percent. To meet the food security, income and nutritional needs of the projected population in 2020 the food production in India will have to be almost doubled. The need of the hour is therefore, maximizing the production per drop of water. Hence in the present day

context, lot of emphasis is being given in improving the irrigation practices to increase the crop production and to sustain the productivity levels. Microirrigation is introduced primarily to save water and increase the water use efficiency in agriculture. Reduction in water consumption due to microirrigation over the surface method of irrigation varies from 30 to 70 percent and productivity gain in the range of 20 to 90 percent for different crops. By introducing microirrigation, it is possible to increase the yield potential of crops by three fold with the same quantity of water.

Microirrigation

Microirrigation refers to low pressure irrigation systems that spray, mist, sprinkle or drip. The water discharge patterns differ because emission devices are designed for specific applications due to agronomic or horticultural requirements. The term "microirrigation" describes a family of irrigation systems that apply water through small devices. These devices deliver water on to the soil surface very near the plant or below the soil surface directly into the plant root zone. Growers, producers and landscapers have adapted microirrigation systems to suit their needs for precision water application. Microirrigation systems are immensely popular not only in arid regions and urban settings but also in subhumid and humid zones where water supplies are limited or water is expensive. In irrigated agriculture, microirrigation is used extensively for row crops, mulched crops, orchards, gardens, greenhouses and nurseries. In urban landscapes, microirrigation is widely used with ornamental plantings. Microirrigation components include pipes, tubes, water emitting devices, flow control equipment, installation tools, fittings and accessories. For first time users, it can be a confusing array of components and gadgets. It can be a challenge to select the right type of system and assemble the components suitable for irrigation needs. A description of various microirrigation systems, its many uses and limitations will help.

The microirrigation techniques such as drip irrigation, microsprayer, microsprinkler, microjet, bubbler, pitcher and subsurface drip irrigation system etc, is a technology that offer unique, agronomic, water conservation and economic advantage that address the challenges for irrigated agriculture in future.

Drip irrigation system

Drip irrigation is the technique of slow application of water in the form of discrete or continuous drop or tiny stream or miniature sprays through mechanical devices called

drippers or emitters. Drips/trickles are generally single outlet devices positioned at the tree or plant root zone along a polyethylene (PE) lateral line. The water in the drip/trickle flows a fine labyrinth with a zigzag path, which creates a pressure loss. The cross sectional area in which the water flows is thereby larger and these emitters are less vulnerable to clogging. The usual flow rates are 1-2-4-6-8-12-16 L/hr at a pressure range between 0.5 - 4.0 bar. The tube diameter can be 12-16-20-22 mm and the emitter spacing 0.3-0.4-0.5-0.6-0.75-1.0-1.25-1.5 m

The manufacturers' catalogue usually shows the size of the tube, the possible spacing of the emitters, the flow rate of the dripper, the operational pressure and the maximum length of the lateral. Depending on how the emitters are placed in the plastic PE distribution line, the drip can be as a line source in line or a point source on line. The line source/in line type emitters are placed internally in equally spaced holes or slits made along the line. Water applied from the close and equally spaced holes usually runs along the line and forms a continuous wetting pattern. This wetting pattern is suited for any row crops.

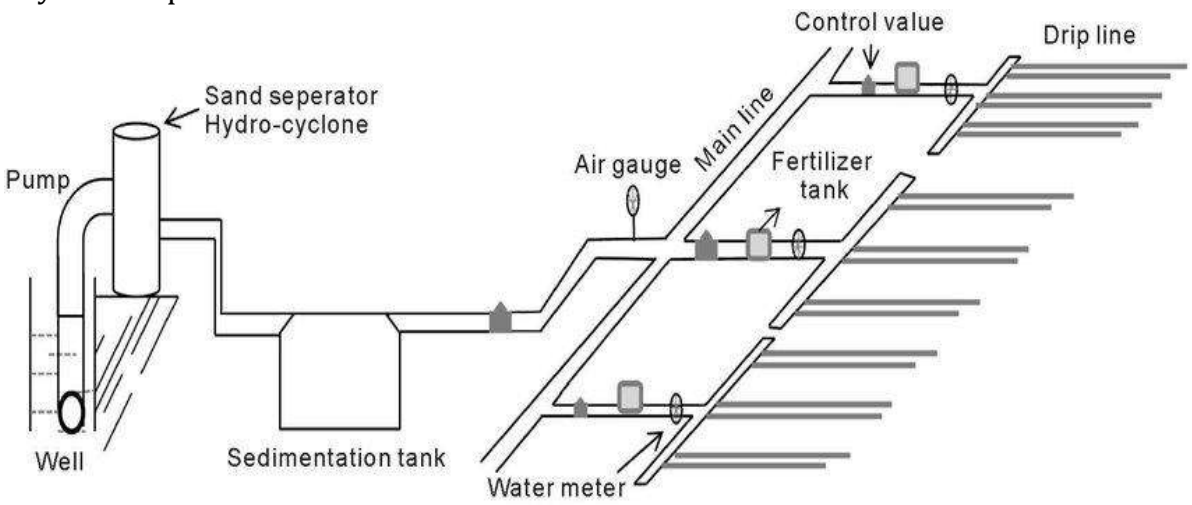

Figure 2. Layout for Drip irrigation

Microsprayer

Microsprayers are small, non-rotating sprinklers with flow rates ranging from 20-150 L/hr and the radius of 1.0-3.0 m. The shape of the wetted area varies depending on the type of the spray used. These units are relatively vulnerable to clogging and require fine filtration from 120-150 microns and are mostly used in tree crops. They are fixed to small plastic wedges 0.20-0.30 m above ground and they are connected to the polyethylene (PE) laterals with 7-9 mm flexible plastic tubes 0.60-1.20 m long, usually placed one per tree 0.30-0.50 m apart or between the trees. Most of them are insect protected.

The manufacturer's catalogue usually shows the sprayer type, nozzle colour and diameter, flow rate, pressure, wetted diameter, proposed lateral size, spacing between sprayers and the maximum number of sprayers per lateral. Based on the nozzle colour/size, one sprayer head can be used by changing the nozzle only to achieve various application rates and wetted diameters. Some of the sprayers can operate

upside down to reduce the wetting diameter for irrigating young trees and they can be pressure compensating and non drain attaching a non drip device to the sprayer.

Microjets

Microjets apply water at higher rates than drippers along band of soil along the row, have no moving parts and there is a limit to their distance of throw. They are small, non-rotating sprinklers with nozzle diameter between 1.0-5.0 mm, with flow rates ranging from 19-220 L/hr at operating pressures of 1.0-3.5 bars with wetted diameters of 1.4-9.5 m. They are fixed to small plastic wedges 20-30 cm above ground and they are connected to the PE laterals with 7-9 mm flexible plastic tubes 60-120 cm long, usually placed one per tree 30-50 cm apart.

Microsprinklers

Microsprinklers or minisprinklers are small plastic sprinklers of low capacity with flow rates less than 300 L/hr. Suitable for wide range of row crops (tree crops and vegetables) that require a medium to low flow irrigation system with optimal clog free capacity and exceptional distribution uniformity. The microsprinklers can have various swivels or rotators. Their main characteristics are their rapid rotation/whirling, the very small size of the water drops and the long angle of the water spray above nozzle. Microsprinklers incorporate a moving part, therefore discharge the water over a greater area in a full circle. They have only one nozzle outlet ranged between 1.0-2.3 mm in diameter for microsprinklers with swivels and 0.7-2.8 mm with rotators with discharge rates 23-400 L/hr with swivels and 20-1200 L/hr with rotators at operating pressures of 1.0-3.5 bar for swivels and 1.5-4.5 bar for rotators and wetted diameters between 1.3-8.8 m with swivels and 1.6-23.1 m with rotators.

The manufacturers' catalogue usually shows the sprinkler type, nozzle colour and diameter, flow rate, pressure, wetted diameter, proposed lateral size, spacing between sprinklers and the maximum number of sprinklers per lateral. Based on the nozzle colour/size, one sprinkler head can be used by changing the nozzle only to achieve various application rates and wetted diameters. Easy to swap.

Figure 3. Microsprinkler

Bubbler irrigation

Bubblers typically apply water on a 'per plant' basis and are very similar to the point source external emitters in shape but differ in performance. Low pressure bubblers are designed for localised 'flood' irrigation of small areas. The bubbler emitters dissipate water pressure through a variety of diaphragm materials and deflect water through small orifices. Most bubbler emitters are pressure compensating. The bubbler emission devices are equipped with single or multiple port outlets. Water from the bubbler head either runs down on the emission device or spreads a few inches in an 'umbrella' pattern. They deliver water in bubbles or in a low stream on the same spot. The flow rate is adjusted by twisting the top and ranges from 110-250 L/hr at an operating pressure of 1-3 bar. Most bubbler heads are used for tree (1 or 2 per tree), planter boxes and landscape applications.

Figure 4. Bubbler irrigation

Pitcher irrigation

Young fruit plants are irrigated by this method, especially in drought prone areas. Mud pots of 20 litre capacity with a small hole of 0.3-0.4 mm in diameter at a height of 5 cm from the bottom are buried neck deep in the basins of fruit plants about 35 cm from the stem. These mud pots have narrow neck and a lid. The pots are filled with water once a week or once in ten days depending upon the soil, climate and nature of the plant and the pot covered with the lid. Water trickles down slowly from the pot into the root zone of fruit plant.

Subsurface drip irrigation (SDI)

Subsurface drip irrigation (SDI) is a type of microirrigation system using drip tube or tape, installed below the root zone. It is the slow, frequent application of water to the soil profile directly to the root zone of plants, beneath the soil surface. Allows the precise application of water, nutrients and other chemicals. Properly managed SDI

systems wet the root zone uniformly through the field while maintaining a dry soil surface.

ADVANTAGES OF MICROIRRIGATION SYSTEMS (MIS)

Microirrigation systems have many potential advantages when compared with other irrigation methods. Most of them are related to the low rates of water application. It can be argued that some of these benefits are not unique to a microirrigation system. However, certain combinations of these advantages are responsible for uniqueness of microirrigation in contrast to other systems.

1. Water savings

Irrigation water requirements can be smaller with microirrigation when compared with other irrigation methods. This is due to irrigation of a smaller portion of the soil volume, decreased evaporation from the soil surface, and the reduction or elimination of the runoff. The losses due to the evaporation from the soil are significantly reduced compared with other irrigation systems since only a small surface area under the plant is wetted and it is usually well shaded by the foliage. Since the microirrigation system allows for a high level of water control application, water can be applied only when needed and deep percolation can be minimized or avoided.

2. Smaller flow rates

Since the rate of water application in microirrigation systems is significantly lower than in other systems, smaller sources of water can be used for irrigation of the same acreage. The delivery pipes, the pump, and other components of the system can be smaller and therefore more economical. The systems operate under low pressure (5-30 psi) and require less energy for pumping than high pressure systems.

3. Application of chemicals (Chemigation)

Microirrigation systems allow for a high level of control of chemical applications. The plants can be supplied with the exact amount of fertilizer required at a given time. Since they are applied directly to the root zone a reduction in the total amount of fertilizer used is possible. There is also an advantage to the frequent application of fertilizers through the system in humid climate. In case of rain, only a small portion of recently applied fertilizer will be washed out and it can be easily replaced through the irrigation system. This application method is more economical, provides better distribution of nutrients throughout the season, and decreases ground water pollution due to the high concentration of chemicals that could ordinarily move with deep percolated water. Other chemicals, such as herbicides, insecticides, fungicides, nematicides , growth regulators and carbon dioxide can be efficiently applied through microirrigation systems to improve crop production.

4. Water sources with high salt content

A significant advantage of microirrigation is that water with relatively high salt content can be used by the system. For optimum plant growth a certain range of total

water potential in the root zone must be maintained. The potential defines how difficult it is for a plant to extract water from the soil. Large negative numbers are characteristic of very dry soils with low total water potentials while potentials near zero reflect soils near saturation. The total water potential in the root zone is a sum of the matric potential and osmotic potential. Since matric potential is close to zero under microirrigation (high moisture content) the osmotic potential component can be a relatively large negative value, indicating high salt content, without harmful effect on plant growth. This is not true for other irrigation systems.

5. Improved quality of the crop

Microirrigated plants are supplied very frequently with small amounts of water and the stress due to the moisture fluctuation in the root zone is reduced to the minimum, often resulting in larger and better quality yield. In arid climates, or during dry seasons, the harvest timing can be controlled by proper water management.

6. Adaptation to any topography

Microirrigation systems can operate efficiently on hilly terrain if appropriately designed and managed. Well managed microirrigation system will not create runoff even on hilly terrain.

7. Additional advantages of microirrigation systems

During dry seasons or in arid climates disease and insect damage can be reduced under microirrigation system since the foliage of the plant is not wetted. With a small portion of soil surface being watered, field operations can be continued during irrigation. The water distribution is not affected by the wind for drip irrigation. However, wind can have some effect on jet spray patterns. Since only the portion of the soil surface is wetted/water uptake by the weeds between the rows can also be significantly reduced. Microirrigation systems can also be extensively automated decreasing labour and operating costs.

POTENTIAL PROBLEMS IN MICROIRRIGATION

To operate satisfactorily, a microirrigation system have to be correctly designed and managed to account for the physical properties of soil, quality of irrigation water, and water requirement of the grown plants. This type of system definitely requires a higher management level than other irrigation systems. With all the advantages listed above, a microirrigation system is not a system without problems.

1. Clogging

One of the biggest problems encountered under microirrigation is clogging of the emitters. The small openings can be easily clogged by soil particles, organic matter, bacterial slime, algae or chemical precipitates. The microirrigation system requires very good filtration (most often recommended is 200 mesh screen) even with a good quality water supply.

2. Moisture distribution

Moisture distribution depends largely on the soil type being irrigated by the micro system. In some soils, for example deep sands, very little lateral water movement (low capillary forces) can create many problems. The wetted volume has a shape approaching a cylinder rather than a hemisphere since gravity forces dominate. Under these conditions it is difficult to wet a significant portion of the root zone. It is also more difficult to manage the irrigation without deep percolation since only a small amount of water can be stored in the wetted volume desired. Increasing the number of emitters per plant may improve water distribution in the soil. As a result, coarse sands will require much closer spacing of emitters than fine soils. In general, for any soil, the number of emitters and their spacing must be based on the geometry of wetted soil volume. It is important to realize that the micro irrigation system wets only a limited portion of the potential soil root volume. Most of the plants can perform very well under these conditions. However, there is a minimum volume of roots which has to be wetted or a reduction in yield will be observed.

3. Salt build up

Microirrigation systems can use saline water. However, a problem may occur from salts accumulating at the edges of the wetted zone during prolonged dry periods. Light rain can wash these salts into the root zone and cause injury to the plants. In arid climates, where the rainfall is less than 10 inches per year, an additional irrigation system (sprinkler or surface) may be necessary to leach accumulated salts from the soil between growing seasons. In areas with heavy rainfall the salts will be washed out of the root zone before significant accumulation occurs.

4. Initial cost

The initial investment and maintenance cost for a microirrigation system may be higher than for some other irrigation methods. Filters, chemical injectors and possible automation components add to the cost of a microirrigation system. Actual costs will vary considerably depending on the selection of a particular micro system, required filtration equipment, water quality, water treatment and selection of automation equipment.

5. Additional drawbacks

Rodents and insects can create additional maintenance problems by chewing holes in the plastic. In addition, some components of the system can be easily damaged by persons unaware of their locations. A microirrigation system does not provide significant frost protection; therefore it is not suitable

SUMMARY

Microirrigation techniques provide an array of technologies which have not only helped in conservation of water but also ensured its timely supply and efficient use. Different microirrigation methods like drip irrigation, microsprayer, microsprinkler, microjet, bubbler, pitcher and subsurface drip irrigation system along with mulch and proper crop geometry increases the water use efficiency and yields of crops by many folds.

Microirrigation techniques have materialized the concept of 'more crop per drop, by insuring the availability of adequate quantity and quality of water especially in dryland agriculture where water is the most limiting factor in crop production. There is a need of realistic proactive promotion policies to convert microirrigation technologies to "general farmers" instead of confined to "gentlemen farmers". The participatory approaches that encourage and support the creativity and innovation of farmers, by offering options that can be adapted and combined as needed. There is a need to materialize the feasibility of "custom solutions to package solutions to farmers assembled systems" more actively. It is also a need to accommodate NGOs and other private partners for effectively bridging the gap between the supply and demand of microirrigation technologies.

Future Smart Food: The Need of Hour

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Future smart food are those crops that are not traded internationally and less attention is provided to them in terms of research of agricultural training and extension. These are grown in Asia, Africa and South America. Generally these constitute major part of local diet. In comparison to major food crops like rice, wheat and maize, breeding technology for orphan crops is far away behind. Similar to major crops, orphan crops are also member of different types of food i.e. cereals, legumes, vegetables, root and tuber crops. These are also called as neglected, minor, orphan, promising, niche, traditional, alternative crops, future smart food and many more. According to crops for the future, 'neglected' means no major research done by researcher and scientists, 'orphan' means having no crop experts, 'minor' means in relation to major food crops, 'future smart food' means having major role in future food security. Major categories of Future Smart Food:

1. Millets

a. Finger millet (*Eleusine coracana*)
b. Foxtail millet (*Setaria italica*)
c. Porso millet (*Panicum miliaceum*)
d. Kodo millet (*Paspalum scobiculatum*)
e. Little millet (*Panicum sumatrense*)
f. Barnyard millet (*Echinochloa crusgalli*)
g. Pearl millet (*Pennisetum glaucum*)

Millets ere tolerant to moisture deficit and have great suitability in semi arid region of Asia and Africa, especially in drought situation (William and Haq.,2000). According to FAOSTAT 2018, these crops are being cultivated on 32.2 million hectare area in India, Niger, Sudan, Nigeria and Chad.

2. Pseudocereals

These crops are having close relationship to 'true cereals' in terms of carbohydrate composition but are called pseudocerals as they have 2 cotyledons unlike grasses having single cotyledons. Buckwheat, Amaranthus and Quinoa are major crops of this

group. These crops are free of gluten and have several health related benefits like anti-cancer, anti-hypertensive, anti-inflammatory and prevention of heart diseases.

3. Legumes/Pulses

Crops like horse gram, cowpea, pigeon pea, chickpea, grass pea and lentil constitute this group. These are highly nutritious and drought tolerant.

4. Vegetables

Okra, Moringa and Baobab constitute this group. Every part of Moringa tree is highly nutritious. Baobab is a multipurpose tree with leaves rich in iron and good amount of vitamin C in its fruits.

5. Oilseeds

Castor bean, linseed and sesame are important crops.

6. Root and Tuber crops

Cassava, Sweet potato and Yam are important crops of this group. Cassava is highly tolerant to drought and gives good results on soils with fewer nutrients.

7. Fruits

Banana and Plantain (Musa sp.) constitute this group. Orange pulped type banana has high carotenoid and iron content and can help in reducing iron and vitamin A deficiency.
Benefits of Future Smart food in current situation:

1. Under changing climate, these crops will help in improving agricultural sustainability.
2. Provide healthy and sustainable food system
3. Provide good reserve of genetic resource for future crop improvement

Changing Climate and Future Smart Food:

As we know that impacts of climate change are putting excessive pressure on our natural resource base and thus resilience of agro eco system is getting reduced, which are providing food and nutritional security in rural communities. To tackle out the problems of climate change, there is urgent need of shift from present adaptation techniques/strategies towards transformative alternatives which give equal emphasis on health as well as nutrition of human and also provide equal efforts for environmental sustainability (Francis et. al. 2017). Here involvement of nutrient rich orphan crops into marginalized agricultural systems and dominant food system is the important transformative adaptation. New opportunities can be obtained from these crops as these are uniquely well suited to local harsh environments, also increase agro-biodiversity in the given region and also offer nutritional diversity. When compared to major crops, it has been shown that most orphan crops are low yielding but these have certain peculiar traits which may be useful for climate change adaptation.
Growth of crops will be affected in changing climate in terms of phenology, heat stress, water stress, increased infestation of pest and diseases. In fact, it is forecasted that in

2050, there will be yield changes from -27 to +9% across all the developing countries for three major crops (Rice, Wheat and Maize).

Need of giving attention to Future Smart Food:

1. Rich source of vitamins, minerals, phyto-chemicals and antioxidants. Thus will help in removing the problem of malnutrition.
2. Able to adapt to harsh conditions suggesting their suitability in changing climate.
3. Provide cheap and environment friendly option to resource poor communities as these do not require large amount of fertilizers and agrochemicals.
4. Different mechanisms and gene alleles for resilience under stress and growth in poor environment are present in orphan crops which are lost from major crops.
5. Several orphan crops require less water and have high water use efficiency, thus making them suitable in areas having water shortage problems.
6. Land which is not suitable for growing major crops may be suitable for the cultivation of adaptable orphan crops. It will result in better utilization of land.
7. These crops help in disrupting pest and disease cycles of major crops and will also increase the presence of pollinators.

Future Smart Food in our diet:

Worldwide, around 12000 crop species are classified as suitable for human consumption, yet 30 crops play important role in feeding the world and to our utter surprise out of that, 60% of world population's dietary energy is fed by rice, maize and wheat. This is mainly due to strong policy support, target breeding efforts and trade policies in favor of major food crops. Beside these factors changes in traditional food habits have resulted in an overdependence on energy rich and nutrient poor staple crops.

Ways to bring Future Smart Food in mainstream:

1. Research policies
2. Trade system
3. Value addition
4. Seed production system
5. Marketing system

Conclusion

We are living in the era where there is requirement of surplus food grains to feed the increasing population but along with this we need to provide healthy and nutritious food from limited resources. We are concerned about food grain production in changing climate scenario as it is expected that it will have negative effect on food grain production as well as quality in crop plants that use three-carbon-fixation pathway (Rice, Wheat and Soybean).For maintaining sustainability in agriculture food system it is very necessary to widen the genetic resource base. These crops provide huge opportunities for adding variety to our food basket in terms of quantity and nutritive value.

The importance of legumes in cereal cropping systems

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IMPORTANCE OF LEGUMES

For the regeneration of nutrient-deficient soils and for providing needed protein, minerals and vitamins to humans and livestock we need to increase the cultivation of legumes. Legumes can a means of improving the livelihoods of smallholder farmers around the world.

Legumes in human nutrition

As a source of protein:Legumes of grainsuch as pigeon pea, chick pea, soyabean or mung beans are rich in protein content ranging from 17-40%. Proper balance of protein and nutritional improvement can be achieve with the addition of cereal and grain consumption, to farmers and their families.

As a source of important vitamins and minerals: Significant amounts of minerals (Calcium, Zinc and Iron) and vitamins (folic acid and vitamin B) contained by legume seeds.

As a way of reducing cholesterol and blood sugar.

Legumes for animal nutrition

Cereal crop residue supplemented with forage legumes significantly increase overall animal productivity. For instance, when pulse grains are included in poultry feedincreased poultry egg production has been reported. Adding the residue from legume plants into livestock forage can increase the digestibility and overall quality of cereal crop residues. For instance, maize residue tend to be high in carbohydrates but low in protein, therefore adding leguminous plants will contribute to improved livestock nutrition.

Legumes for crop and soil improvement

Nitrogen is the main mineral nutrition which is required for optimum yieldrequirement of mineral nutrition is required crops. Exhausted soils often low in nitrogen, which means that farmers normally need to apply inorganic fertilizers to get optimum yield. However,as cost of fertilizer increases, farmers need to struggle to get good yield. This aberrant can be overcome only done added by incorporating legumes into the cropping system.

Nitogen fixing bacteria called *Rhizobium*have a special relationship withleguminous plants. By biologically fixing nitrogen levels in soil, legumes provide a relative low-cost method of replacing nitrogen in the soil, enhancing soil fertility and boosting subsequent crop yields.

Legumes can be incorporated into cereal cropping systems in a variety of ways:

- Green manuring
- Intercropping
- Grain-legume rotations
- Leguminous shrubs

General term used for plants that enrich soil fertility and nitrogen fixation can be called as **green manure**. Green manuring with legume involves growing the plants, then slashing the crop and leaving it on the soil surface has an additional benefits, as it also reduces soil erosion and conserves soil moisture.

A drawback with green manuring is that it involves the loss of a growing season, since the grain is not harvested from the legumes as green manures does not provide the benefits to human diets. Conversely, when quality of soil is low and cost of fertilizer is high than we need to switch to green manuring is an option for farmers to consider, especially in regions with longer growing seasons.

To additional benefit from the present growing season, **intercropping** or **relay intercropping** with legumes is a good alternative. Withintercropping alternative rows of the cereal crop and legume may compete with the cereal crop for water and nutrients, reducing the yield of both crops, Competition for resources is reduced with relay intercropping, the cereal crop is sown first, followed by the legume a few weeks later. Adoption of green manuring results, improvementof nitrogen content and grain yield has been noticed.

Rotation of legumes crop has also been done with cereal crops. This improved cropping system is proposed to offer the farmer with a valuable harvest while at the same time improving the soilfertility. However, after harvesting of legume crop leftover part is treated as green manure which fixes nitrogen too approximately to 5-15 kg/ha of nitrogen fertilizer. Farmers need to maximize the productivity of the legume crop in addition to the cereal crop for getting full benefit from the cropping system.

It is important to choose the legume carefully, taking the cereal crop into the consederation. For example, soyabeans, pigeon peas and mungbeans are recommended as relay crops within rice cropping systems. As intercrops with wheat,lathyrus,lentils and chickpeas are recommended. In maize, pigeon pea, sunn hemp and cow pea have positive effects, but vigorous climbers such as velvet bean can choke the maize plants and make harvesting difficult.

Leguminous shrubs can also improve soil quality. We can grow the shrubs in rotation with cereal crop and by cutting the shrubs can produce fodder and mulch. Although, this substitute does involve the loss of a growing season whereas, to grow leguminous shrubs as hedgerows as second option in either within or around the field. Pruning of bushes and the clipping can be used as mulch on soil surface. Farmers can also produce honey during the flowering period as an added advantage of these shrubs.

Constraints of legume production

- Farmers need to learn to control the presents new diseases, pests, and weeds, of leguminous crop.
- Low soil pH, high salanity, flooding, and nutrient deficiencies can negatively impact the nitrogen fixation process, preventing the legumes from improving soil fertility to their full potential.
- Legumes growing or sowing of legume crop is done on available soil moisture conditions. Non availability of irrigation or reduced irrigation may lead to drought stress.

Management practices for increasing nitrogen use efficiency in field crops

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In many of the world's agricultural areas, nitrogen is one of the most limiting nutrients for crop production and its efficient use is necessary for the economic sustainability of cropping systems. Moreover, N is highly dynamic in nature and its tendency to loss from soil-plant systems generates unique and challenging environment for its efficient management. Nitrogen use efficiency and crop response to applied N are important criteria for evaluating crop N requirements for maximum economic yield.Recovery efficiency of N in crop plants is usually less than 50%. Low recovery of N in field crop is associated with its losses via volatilization, leaching, denitrification, surface runoff, and plant canopy. Low recovery of N is responsible for higher cost of crop production and environmental pollution. Therefore, enhancing N use efficiency is desirable for improving crop yields,
maintaining environmental quality and reducing cost of production. Integrated N management strategies should be taken into consideration for improving N use efficiency along with soil and crop management practices. Nitrogen use efficiency (NUE) is the fraction of applied nitrogen that is absorbed and used by the plant. Improving a plant's ability to utilize nitrogen is a key component in enhancing environmental sustainability.

INCREASING FERTILIZER NUE IN CROPS

There is a need to moderate the use of nitrogen fertilizer in agricultural systems by increasing the NUE. The use efficiency of nitrogen in India is very low: 30-40% in rice and 40-60% in other crops. The lower NUE in farmer's field is due to lower level of management practices under natural farming conditions and spatial variability of factors controlling indices of NUE. On a global scale, at least 50% of fertilizer-N applied to the crops is lost from the agricultural systems and major losses occur during fertilizer application. Low NUE not only leads to financial loss to the farmers and government but it also creates environmental issues. Therefore, for minimising the losses during fertilizer application, nitrogen and crop management must be fine-tuned in the cropping season in order to maximize NUE. Fine –tuning of fertilizer doses for all crops are based

on precise soil-crop requirement estimations through soil analysis and crop diagnosis, would be key components in precision N management.
Different management strategies adopted widely are :

1. Best management practices for NUE

The best management practices (BMPs) provides a framework for achieving goals of cropping system i.e; increasing production, increased profitability, enhanced environmental protection and improved sustainability. The aim of these BMPs is to match the nutrient supply with crop requirements and to minimize nutrient losses from fields. Selection of BMPs for fertilizer management varies with location, soil type, climatic conditions, crop management conditions and other site specific factors. Management strategies are majorly dependent on 4Rs –right N source, right time of application, right N rate and right place. The right source of nitrogen may vary with the crop, the soil properties of the field and methods of application. Right source of N must consider nutrient interactions or compatibility issues and sensitivity of source to plants. The right N rate considers the supplying power of the soil in relation to the N requirement of the crop. Soil and plant analysis are most important tools to help in such decisions. Excessive rates of fertilizer application may leads to inefficiency in nutrient use and economic losses. Therefore, application rates should be according to the plant requirement at different stages of the growing season. Timing also has major effect on the efficiency of N management systems. Nitrogen should be applied in adequate amount when the crop needs it, to avoid periods of significant losses. If significant losses are due to denitrification or leaching then split application – the application of N fertilizers at multiple times during growing season helps in improving NUE and reduce losses. N application at right place helps to ensure that plant roots can absorb sufficient nutrients throughout the growing period.

2. Real time site-specific N management

Site-specific nitrogen management is used to synchronize the supply and demand of nitrogen, and it can be used to manage nitrogen in labour intensive small-scale farming or highly mechanized large scale production fields. Optimum nitrogen rates vary spatially and seasonally, thus diagnostic tools are required to assess soil or crop nitrogen status during the growing season to make decisions on the amount of nitrogen to be applied. Several techniques are used to measure greenness including near-infrared leaf nitrogen analysis, chlorophyll meters, leaf colour charts (LCC), crop canopy reflectance sensors and ground based remote sensors. Over last decades, chlorophyll meter, LCC and hand held green seeker have been extensively used to improve N use efficiency in cereals grown in different regions.

(a) Leaf colour chart: LCC developed by International Rice Research Institute (IRRI) for N management in rice. It is an inexpensive and simple tool for monitoring leaf greenness and guides the application of N to maintain optimum leaf N content. A standardized LCC have four panels ranging from yellowish

green to dark green. LCC can be used to determine the amount and timing of N fertilizer application in rice, wheat, maize and other crops.

(b) Chlorophyll meter: The SPAD (Subsystem Positioning Aid Device) meter or chlorophyll meter has been developed to help estimation of N status of plants. The SPAD meter instantly measure chlorophyll content or greenness of plants to reduce the risk of nutrient deficiencies limiting yield or over fertilization. SPAD quantifies subtle changes in plant health long before they are visible to the human. SPAD measurements and leaf N content has strong relationship that suggests N status of plants and then used for formulating N recommendations.

(c) Optical sensors: Some other tools used for N management are optical sensors whichincludes Green Seeker, the crop circle and rapid scan CS-45 sensors. These are used as single hand held unit or mounted on tool bar. These emit standard wavelength light beams and measure the reflected light back to the unit from leaves. Green seeker sensor measures the reflectance and compute the NDVI (Normalized Differential Vegetation Index) value related to the amountof plant material in the field of view and its greenness.

3. Use of controlled and slow release fertilizer

Other ways for improving NUE is the use of slow release or stabilized N fertilizers, which hold the nitrogen until the plants require it. These fertilizers reduce the N losses, decrease the labour costs and protect the environment. The ideal fertilizers should release nutrients in a sigmoidal pattern for optimal plant nutrition. As compared to the large amount of fertilizers used throughout world, the total use of slow release fertilizers is still small and comprises only 0.15% of the total use of nutrients.

(A) Controlled release fertilizers

i. <u>Stabilized N fertilizers:</u> A fertilizer to which a N stabilizer has been added is called as stabilized N fertilizer. N stabilizer are the substances such as nitrification and urease inhibitors, which when added to the fertilizer extend the time that the N component of the fertilizer remains in the soil in urea-N or NH_4-N.

ii.<u>Nitrification inhibitors</u>: The objective of using nitrification inhibitors is to control the leaching anddenitrification losses by keeping nitrogen in the ammonium from for longer period and thus increasing NUE. Nitrification inhibitors delay or inhibit the bacterial oxidation of ammonium ion by depressing the activity of *Nitrosomonas*bacteria in soil. The most common nitrification inhibitors are N-serve, DCD (dicyandiamide), carbon disulphide (CS_2) and 3,4-dimethlypyrazole phosphate. Nitrapyrin and DCD are the proven inhibitors as nitrapyrin delay nitrification by 82% and DCD by 53% in 14 days.

iii.<u>Neem cake coated urea:</u>Neem (Azadirachtaindica) cake coated urea have nitrification inhibiting properties has been developed in India. Use of neem coated urea has increased the yield by 6-11% in rice. Triterpenes in neem are the major factors in nitrification inhibition responsible for N regulation.

iv.<u>Urease inhibitors</u>: A chemical that inhibits the hydrolytic action on urea by enzyme urease is called as Urease inhibitor. These are generally used to slow down the conversion of urea to ammonium and nitrate. They can inhibit urea hydrolysis by two

weeks or more depending on the soil type and climatic conditions. The major advantages of urease inhibitors are: reduction in volatilization losses of ammonia, improvement of N use efficiency and decrease in the N oxides and nitrous oxide emissions. The potential urease inhibitors are NBPT (N-(n-butyl) thiophosphorictriamide, hydrquinone (HQ), phenyl phosphorodiamidate (PPD).

(B) SLOW RELEASE FERTILIZERS

(i)Sulphur coated urea: one of the most commonly used coatings is sulphur which is used for protecting urea granules from dissolution. Coating of sulphur act as impermeable layer that slowly degrades through microbial, chemical and physical processes. Due to relatively low cost and simplicity sulphur coated urea has become the most commonly used coated urea product in many parts of the world.

(ii)Polymer coated urea (PUC):PUC is coated with special type of polymer coating that act as semipermeable membranes or impermeable membranes. Water moves in through coating to dissolve urea and N diffuses out through porous polymer membrane. These products release the nutrients at the time of plant nutrient uptake thereby increasing NUE.

(iii) Urea supergranules (USG): These supergranules are of 1cm diameter and 1 g weight. Advantages of USG are that it reduces volatilization losses and placement of high amount of urea at a micro-locus produces high concentrations of ammonium ions, inhibiting nitrification.

CONCLUSION

High NUE can be achieved by choosing the most suitable type and rate of fertilizer, the most appropriate application methods (e.g. band placement into root zone, split application, Fertigation), and developing special type of fertilizers (slow and controlled release fertilizers). These newly developed fertilizer products can play a important role in the global quest for increasing NUE but their significance varies by regions and cropping systems. As compared to conventional fertilizers use of slow and controlled fertilizers is still small and limited in India.

Abbreviations:

NUE: Nitrogen use efficiency, LCC: leaf color chart, BMP: best management practices, SPAD: Subsystem Positioning Aid Device, PUC- polymer coated urea

Zero Budget Natural Farming in India and Way Ahead

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While seeing the present situation in agriculture sector, we are again trying to move towards natural way of farming and zero budget natural farming is one of the steps in this direction. Earliest concept of natural farming came from a Japanese farmer, named Masanobu Fukuoka (known as father of natural farming) while in India, Bhaskar Save is acclaimed 'Gandhi of Natural Farming'. According to Bhaskar Save: "Non-violence, the essential mark of cultural and spiritual evolution, is only possible through natural farming. The concept of Zero Budget Natural Farming (ZBNF) is brought into the mainstream by Shri Subhash Palekar, for which he got 'Padam Shri' in 2016. State governments of many states (Andhra Pradesh, Chattisgarh, Himachal Pradesh, Uttarakhand, Kerala and Karnatka) have requested him to train their farmers. According to him, use of dung and urine of one indigenous cow for area of 30 acre and recommends use of Agniastra, Brahmastra and Neemastra, all of which are made from natural ingredients on farm itself.

This concept started from state of Karnatka. During, 1960s, the Green Revolution resulted in use of large amount of chemical fertilizers and use of high yielding Hybrid seed. This promoted the farmers to use chemicals indiscriminately in their fields and use hybrid seed only which resulted in degradation of soil, air, water environment as well as loss of biodiversity.

Zero Budget Natural Farming (ZBNF), which is a set of farming methods, and also a grassroots peasant movement, has spread to various states in India. It has attained wide success in southern India, especially the southern Indian state of Karnataka where it first evolved. ZBNF inspires a spirit of volunteerism among its peasant farmer members, who are the main protagonists of the movement. The neoliberalization of the Indian economy led to a deep agrarian crisis that is making small scale farming an unviable vocation. Privatized seeds, inputs, and markets are inaccessible and expensive for peasants. Indian farmers increasingly find themselves in a vicious cycle of debt, because of the high production costs, high interest rates for credit, the volatile market prices of crops, the rising costs of fossil fuel based inputs, and private seeds. More than a quarter of a million farmers have committed suicide in India in the last two decades. Various studies have linked farmer's suicides to debt. Debt is a problem for farmers of all sizes in India. Under such conditions, 'zero budget' farming promises to end a

reliance on loans and drastically cut production costs, ending the debt cycle for desperate farmers.

Natural Farming:

Farming with nature and without chemicals which help in conservation of biodiversity and nurtures the balance.
Zero Budget Natural Farming: 'Budget' stands for credit/expenses and here 'Zero Budget' means no use of credit or no expenses on buying external inputs. So, it is the natural farming with no expenses.

Benefits:

1. More Profit
2. Environment friendly
3. Promotes soil aeration
4. Less water requirement
5. Provide healthy food

The basic "toolkit" of ZBNF methods was put together by Palekar. The four pillars of ZNBF are as follow:
1. **Jivamrita/jeevamrutha** is a fermented microbial culture. It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity; During the 48 hour fermentation process, the aerobic and anaerobic bacteria present in the cow dung and urine multiply as they eat up organic ingredients (like pulse flour). A handful of undisturbed soil is also added to the preparation, as inoculate of native species of microbes and organisms. Jeevamrutha also helps to prevent fungal and bacterial plant diseases. Palekar suggests that Jeevamrutha is only needed for the first 3 years of the transition, after which the system becomes self-sustaining.
Preparation: Put 200 liters of water in a barrel; Add 10 Kg fresh local cow dung and 5 to 10 liters aged cow urine; Add 2 Kg of Jaggery (a local type of brown sugar), 2 Kg of pulse flour and a handful of soil from the bund of the farm. Stir the solution well and let it ferment for 48 hours in the shade. Now jeevamrutha is ready for application. 200 liters of jeevamruta is sufficient for one acre of land. Jeevamrutha Application Apply the jeevamrutha to the crops twice a month in the irrigation water or as a 10% foliar spray.
2. Bijamrita/beejamrutha is a treatment used for seeds, seedlings or any planting material. Bijamrita is effective in protecting young roots from fungus as well as from soil-borne and seedborne diseases that commonly affect plants after the monsoon period. It is composed of similar ingredients as jeevamrutha - local cow dung, a powerful natural fungicide, and cow urine, a strong anti-bacterial liquid, lime, soil. Bijamrita Application as a seed treatment Add Bijamrita to the seeds of any crop: coat them, mixing by hand; dry them well and use them for sowing. For leguminous seeds, just dip them quickly and let them dry.

3. Acchadana - Mulching. According to Palekar, there are three types of mulching: a. Soil Mulch: This protects topsoil during cultivation and does not destroy it by tilling. It promotes aeration and water retention in the soil. Palekar suggests avoiding deep ploughing. b. Straw Mulch: Straw material usually refers to the dried biomass waste of previous crops, but as Palekar suggests, it can be composed of the dead material of any living being (plants, animals, etc). Palekar's approach to soil fertility is very simple – provide dry organic material which will decompose and form humus through the activity of the soil biota which is activated by microbial cultures. c. Live Mulch (symbiotic intercrops and mixed crops): According to Palekar, it is essential to develop multiple cropping patterns of monocotyledons (monocots; Monocotyledons seedlings have one seed leaf) and dicotyledons (dicots; Dicotyledons seedlings have two seed leaves) grown in the same field, to supply all essential elements to the soil and crops. For instance, legumes are of the dicot group and are nitrogen-fixing plants. Monocots such as rice and wheat supply other elements like potash, phosphate and sulphur.

4. **Whapasa** - moisture: Palekar challenges the idea that plant roots need a lot of water, thus countering the over reliance on irrigation in green revolution farming. According to him, what roots need is water vapor. Whapasa is the condition where there are both air molecules and water molecules present in the soil, and he encourages reducing irrigation, irrigating only at noon, in alternate furrows ZBNF farmers report a significant decline in need for irrigation in ZBNF.

Besides above, other important principles of ZBNF are

1. Intercropping – This is primarily how ZBNF gets its "Zero Budget" name. It doesn't mean that the farmer is going to have no costs at all, but rather that any costs will be compensated for by income from intercrops, making farming a close to zero budget activity. Palekar explains in detail the crop and tree associations that work well for the south Asian context.

2. Contours and bunds – To preserve rain water, Palekar explains in detail how to make the contours and bunds, which promote maximum efficacy for different crops.

3. Local species of earthworms. Palekar opposes the use of vermicompost. He claims that the revival of local deep soil earthworms through increased organic matter is most recommended.

4. Cow dung- Accroding to Palekar, dung from the Bos indicus (humped cow) is most beneficial and has the highest concentrations of micro-organisms as compared to European cow breeds such as Holstein. The entire ZBNF method is centred on the Indian cow, which historically has been part of Indian rural life.

Table 1: Composition of pest control cocktail

SI. No.	Name of treatment	Composition	Used for
1.	Agriastra	It is composed of 10 litre Local Cow Urine and 1 Kg Tobacco, 500gm of Green Chili, 500 Gram Local Garlic, 5 Kg Neem leaves pulp (crushed in urine). . For spraying, 2l	It is effective against the pests like Leaf Roller, Stem Borer, Fruit

		Brahmastra is taken in 100 l water.	borer, Pod borer.
2.	Brahmastra	It is prepared by neem leaves, custard apple leaves, lantern camellialeaves, guava leaves, pomegranate leaves, papaya leaves and white dhatura leaves crushed and boiled in urine	It is used to control all of the sucking pests, pod borer, fruit borer etc
3.	Neemastra	It is made up of local cow urine (5l), cow dung (5kg) and neem leaves and neem pulp (5kg) fermented for 24 hrs	It is used for sucking pests & Mealy Bug

NITI Aayog has been among the foremost promoters of Mr. Palekar and the ZBNF method. However, its experts have also warned that multi-location studies are needed to scientifically validate the long-term impact and viability of the model before it can be scaled up and promoted country-wide. The Indian Council of Agricultural Research is studying the ZBNF methods practised by basmati and wheat farmers in Modipuram (Uttar Pradesh), Ludhiana (Punjab), Pantnagar (Uttarakhand) and Kurukshetra (Haryana), evaluating the impact on productivity, economics and soil health including soil organic carbon and soil fertility. If found to be successful, an enabling institutional mechanism could be set up to promote the technology, NITI Aayog vice-chairman Rajiv Kumar has said. The Andhra Pradesh experience is also being monitored closely to judge the need for further public funding support.

Rural Development and Women Empowerment through Self Help Group's

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Poverty and unemployment are a major problem of developing country like India. Population of India increasing day by day but employment rate is not increasing as excepted.in India poverty in rural area is 25.7 per cent of population and in urban area 13.7 per cent of population which clearly can analysis in rural area poverty is more compare to urban area. More compare to urban area and over all poverty is 21.9 per cent of country population. According to NSSO report 2017-18 overall unemployment rate is almost 6.1 per cent. And condition of unemployment rate in female is worse than male, over all female unemployment rate is 8.5 per cent and in rural unemployment rate is 9.8 per cent, which indicate that in India rural area is more under develop than urban area. Rural development is the process of improving the quality of life and economic well-being of people living in relatively isolated areas. The concept of rural development is very important for a country like India, where majority of population of country is living in rural areas. For such a country, development in the true sense can be achieved only when the rural areas are developed. A major rethinking on the existing strategies of rural development in general and women empowerment, in particular, led to the realization that a new approach is needed to 'help the farmers to help themselves'. By Self Help Group in short mostly known as among people as SHGs. it means it shall include those people who develop themselves by their own efforts. Self Help group is a small, economically homogeneous group of rural poor to save and mutually agree to contribute to a common fund voluntarily which will be lent to the members as per the group decision. SHGs contribute towards the economic development and also plays important role in in poverty alleviation and employment generation in rural areas. These groups provide access to credit to their members through different funding agencies and reduce the dependency on moneylenders and other family members. Moreover, these groups incubate the culture of saving among the members capable of creating an environment of share understanding and collective action. Thus, playing an important role in the promotion of social and economic empowerment of rural people. SHGs have formed a platform for building sense of community, a social support system which boosts the self-confidence and sense of equality among the members.Performance of SHGs depends upon the awareness of

members about overall group objectives as well as the capacity of the group to develop members' managerial and technical skills. An ideal group size of 12-20 farmers (either men or women) shall enhance the group efficiency.

These groups play a significant role in the promotion and enrichment of rural people through training and capacity building and involving themselves in income raising activities, reducing production costs and increase net returns. Its launched almost two decade ago, now a days its plays important role in poverty alleviation and employment generation in rural area.

Origin of Self-Help Groups

The origin of Self-Help Groups (SHGs) is the brainchild of Grameen Bank of Bangladesh, founded by Prof. Mohammed Yunus in 1975, who tried out a new approach to rural credit in Bangladesh. Grameen gave loans without asking borrowers either to provide collateral or engage in paper work. In India NABARD initiated SHGs in the year 1986-87 but the real effort was taken after 1991-92 from the linkage of SHGs with the banks. A SHG is a small economically homogeneous affinity group of the rural poor voluntarily coming forward to save a small amount of money regularly, which is deposited in a common fund to meet the members‟ emergency needs and to provide collateral free loans decided by the group. It now addresses the issues of poverty alleviation and empowerment of poor, health, nutrition and other support services especially women, in the rural areas of the country.

The Concept of SHGsis Based on the following Principles

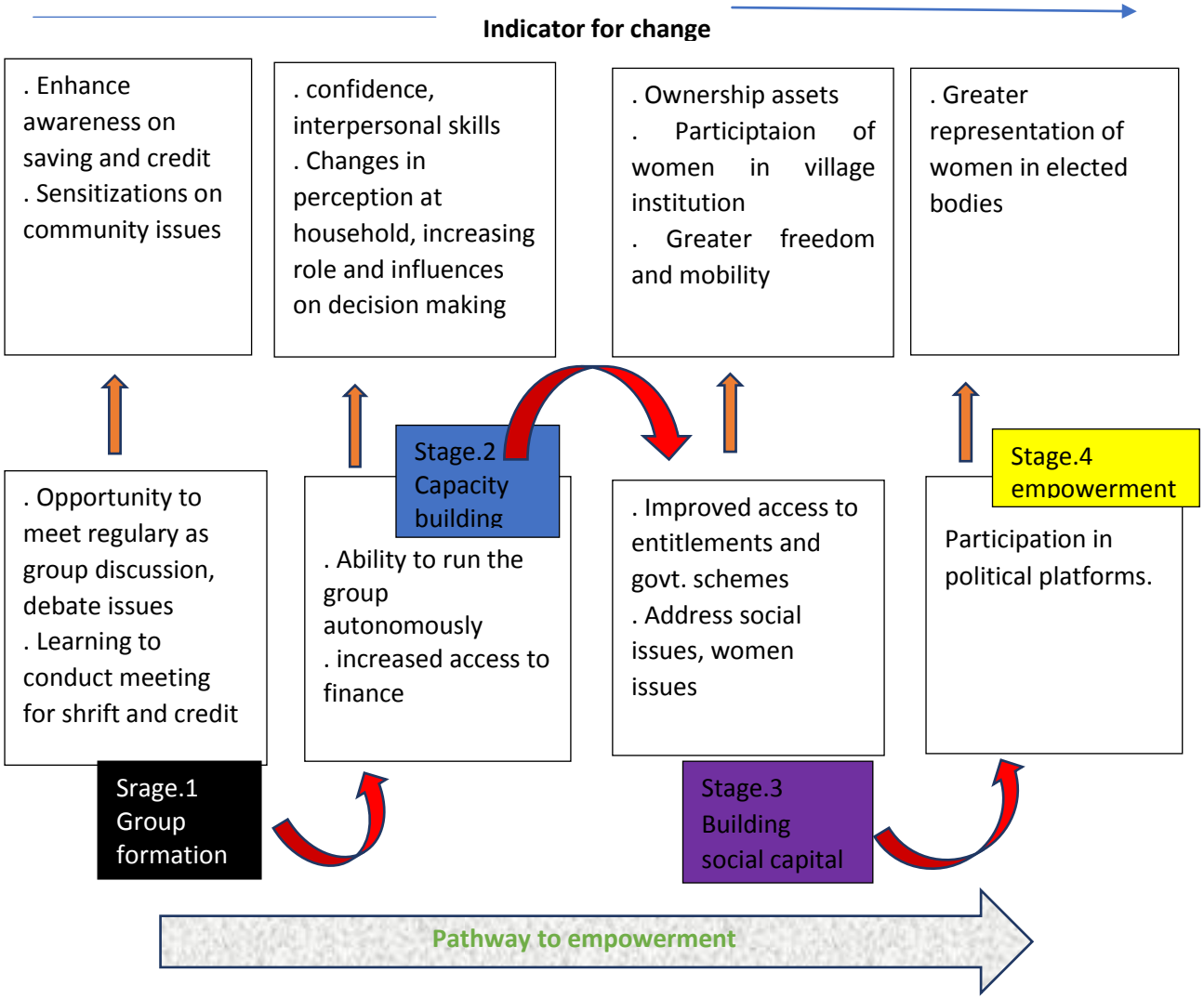
• Self-help supplemented with mutual help can be a powerful vehicle for the poor in their socioeconomic development;
• Participative financial services management is more responsive and efficient;
• Poor need not only credit support, but also savings and other services;
• Poor can save and are bankable and SHGs as clients, result in wider outreach, lower transaction cost and much lower risk costs for the banks;
• Creation of a common fund by contributing small savings on a regular basis;
• Flexible democratic system of working;
• Loaning is done mainly on trust with a bare documentation and without any security;
• Amounts loaned are small, frequent and for short duration;
• Defaults are rare mainly due to group pressure; and
• Periodic meetings non-traditional savings.

SHGS AND RURAL DEVELOPMENT

In order to change the face of socio-economic scenario, micro enterprises and SHGs are playing significant role in the self-employment by raising the level of income and standard of living rural people. In this framework, one of the most vital aspects of rural self-employment is the formation of SHGs which is a valuable investment in human capital through training and capacity building measures. From dairy to mechanized farming, weaving, poultry, food processing units, mushroom cultivation; Rural India has been busy setting up micro-enterprises by forming SHGs. The group

members use collective wisdom and peer pressure to ensure appropriate use of fund and its timely repayment. These are informal groups in nature where members come together towards collective action for common cause. The common need is meeting their emergent economic needs without depending on external help. SHG movement is supposed to build economic self-reliance of rural poor, overcome misuse and create confidence predominantly among women who are mostly unseen in the social structure.

SHGs milestone for women empowerment



Stage I: SHG provides a new opportunity for women to come together, meet regularly, discuss, debate and exchange views on important common issues

Stage II: The emerging financial power through their association with SHG contributes to increase women's influence on household decision making

Stage III: Women start assuming a larger role in their communities like community work, monitoring and implementation of government programmes and schemes and participation in community meetings. They are now seen as active participants in village community

Stage IV: Women graduate from being participant in social and political platforms to a more empowered role where they could successfully contest elections, and assume political power

CONCLUSION

SHGs can play important role in achieving the long-cherished objectives of poverty alleviation and rural development through their diversified programmes. The formation of common interest groups has had a substantial impact on the lives of its member. Empowerment of women and the inculcation of financial training and discipline amongst the poor will undoubtedly have long term socio- economic benefits.it is unique system for poverty eradication involving poor women who work together in order to bring a positive shift in their socio- economic status. It can be hoped that the SHG programme could bring about radical change in the lives of the poor sections of the society in the years to come.

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