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SPRING
Strengthening Partnerships, Results, and Innovations in Nutrition Globally

Farmer Nutrition School Technical Guide






VEGETABLE GARDENING, NATIVE CHICKEN REARING, and POND FISH CULTURE

February 2016

About SPRING
The Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project is a five-year USAID-funded Cooperative Agreement to strengthen global and country efforts to scale up high-impact nutrition practices and policies and improve maternal and child nutrition outcomes. The project is managed by JSI Research & Training Institute, Inc., with partners Helen Keller International, The Manoff Group, Save the Children, and the International Food Policy Research Institute.

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Acronyms

CC	cubic centimeter
DAE	Department of Agricultural Extension
EHA	Essential Hygiene Actions
ENA	Essential Nutrition Actions
FMA	Farm Management Analysis
FNS	Farmer Nutrition School
IPM	Integrated Pest Management
JSI	JSI Research & Training Institute, Inc.
MoP	Muriate of Potash
SPRING	Strengthening Partnerships, Results, and Innovations in Nutrition Globally project
TSP	Triple Super Phosphate
USAID	United States Agency for International Development
WS	water soluble

Use of This Technical Guide

Farmer Nutrition School (FNS) is a community-based learning approach that promotes the Essential Nutrition Actions (ENA) and the Essential Hygiene Actions (EHA) by teaching the production and consumption of vegetables and animal source foods and the installation and use of tippy taps for handwashing at the household level. These interventions support high-quality, micronutrient-rich diets for pregnant and lactating women and children 6 to 24 months old.

The *Farmer Nutrition School Technical Guide* is one of the three documents SPRING/Bangladesh has developed to implement the FNS approach. The other two documents are the *Farmer Nutrition School Session Guide* and the *Farmer Nutrition School Advocacy Guide*. The *Technical Guide* is a companion resource offering more detailed background information and more specific content for FNS trainers and leaders to support the *Session Guide*. Basic and refresher training on these documents, particularly on the *Farmer Nutrition School Technical Guide* and the *Farmer Nutrition School Session Guide*, in addition to regular supportive supervision, are critical to the successful implementation of the FNS approach, especially as it relates to increased food production and the adoption of ENA and EHA practices.

This technical guide—

- should be used by FNS session leaders and supervisors as a primary reference manual to support and enrich FNS training sessions
- will increase the technical competency of FNS facilitators/trainers and their supervisors in the areas of FNS training and in the conduct of follow-up visits
- provides key technical information on vegetable gardening, native chicken rearing, and pond fish culture to be adopted by mothers, fathers, households, and communities to improve the nutrition and health of women and children through increased and year-round production
- can be used for both nutrition-specific and nutrition-sensitive activities.

The *Farmer Nutrition School Technical Guide* includes modules on the production of three nutrient-rich foods. School facilitators/trainers are expected to lead the training session as per the *Farmer Nutrition Session Guide*, and conduct regular follow-up at households of FNS members. This follow-up will ensure that members are practicing what they have learned. It also provides backstopping support for better production and consumption of nutritious food. The three food production modules are:

1. Vegetable Gardening
2. Native Chicken Rearing
3. Pond Fish Culture

Module 1: Vegetable Gardening

Session 1. Homestead Space Planning and Vegetable Bed and Pit Preparation

Topic 1. **Introduction**

In Bangladesh, most rural women do not work or grow crops outside of the home (i.e. in a field). Therefore, the homestead is the only the area where rural women can grow their vegetables, rear their poultry, and culture fish. Each portion of the homestead is important because of its production potential. By properly using the homestead area, a pregnant or lactating woman can easily grow diversified food with minimal cost and effort. Utilization of each portion of homestead land is important because it is a potential space that can be used to produce food and especially to provide better nutrition. At the homestead, best use of available space should be considered when preparing vegetable beds and pits because a well-planned vegetable garden is essential for producing better yields. Using these methods, year-round vegetables can be grown for consumption by pregnant or lactating women and the members of her family.

Topic 2. **Introduction to Diet for Pregnant Women**

See the SPRING *Community Worker Handbook*, Practices: 1. Diet for Pregnant Women (p8); 2. Iron Supplementation during Pregnancy (p9); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Importance of Vegetable, Nutritional Value, and Season-Wise Vegetable Selection and Cultivation**

Importance of Vegetables With Regard To Health and Nutrition

- Most vegetables are rich in nutrients.
- Intake of adequate vegetables helps reduce malnutrition.
- Vegetables increase immunity against diseases.
- They protect against night blindness and general blindness.
- They protect against skin diseases and scurvy.
- They protect against anemia.
- They protect against cancer.
- As a whole, vegetable intake helps to ensure a healthy life.

Different Nutrient Elements in Vegetables

Name of nutrients	Source of nutrients
Vitamin A	Taro leaf, red amaranth, drumstick leaf, stem amaranth, kangkong, carrot, spinach, country bean, yard long bean, Indian spinach, tomato, radish leaf, sweet gourd, bottle gourd leaf, sweet potato leaf, ripen papaya, mango, ripen jackfruit.
Vitamin C	Amla, knolkhol, cabbage, red amaranth, radish, kangkong, bitter gourd, tomato, lemon, green chili, drumstick leaf, Indian spinach, bottle gourd leaf, sweet gourd leaf, hog plum.
Iron	Stem amaranth, red amaranth, jute leaf, bitter gourd leaf, sweet gourd leaf, country bean, yard long bean, taro leaf, okra, brinjal (eggplant), Indian spinach, hog plum, fig, amla.
Calcium	Stem amaranth, red amaranth, taro, knolkhol, carrot, jute leaf, Indian spinach, radish leaf, bitter gourd, okra, country bean, radish, sweet potato leaf, ash gourd, cauliflower, sweet gourd, yard long bean, amla, fig.

Vegetables Grown In Different Seasons

Winter: Spinach, tomato, carrot, radish, cauliflower, cabbage, country bean, bottle gourd, knolkhol, etc.

Summer: Okra, stem amaranth, ash gourd, bitter gourd, sweet potato leaves, snake gourd, kangkong, ribbed gourd, etc.

Throughout the year: Yard long bean, brinjal, kangkong, red amaranth, bitter gourd, sweet gourd, bottle gourd, papaya, green banana, etc.

Topic 4. **Homestead Space Planning or Suitable Area Selection for Vegetable Cultivation**

Vegetable Selection On The Basis Of Homestead Space

Homestead space	Vegetable
Sunny area	All vegetables in bed
Light shady place	Taro, cucumber, spinach, carrot, kangkong, Indian spinach, cabbage, knolkhol, chili
Submerged place	Kangkong, water taro
Trellis	Bitter gourd, ash gourd, bottle gourd, sweet gourd, ribbed gourd, snake gourd
Rooftop	Ash gourd, bottle gourd, sweet gourd, ribbed gourd, snake gourd
Fence	Yard long bean, bitter gourd, ribbed gourd, snake gourd
Fruitless tree	Country bean, sword bean, teasel gourd, yam, yard long bean, ash gourd
In pit	Papaya, chili, brinjal
Unused site beside house	Banana, drumstick
Periphery of homestead	Guava, lemon, papaya, hog plum, sapota, pomelo

Topic 5. **Plantation Pit Preparation**

Steps of Preparing Planting Pits

Site selection

- Prepare the pit at the front, back, or side of the homestead.
- Select a spot that remains sunny throughout the day.
- Make sure that the spot is not submerged or shady.
- Select a spot that will not become water logged due to heavy rain in the rainy season or the tidal effect.
- Select a spot where rainwater can drain quickly.
- Select a site that is easy to access and safe to work in.
- Protect the site from cattle/goat, etc. (fencing).

Pit preparation

- Planting pits have to be dug 10–15 days before sowing seeds.
- The size of the pit should be 18 cubic inches (length 18 inches X width 18 inches X depth 18 inches).

- The distance from one pit to another should be 3 to 4 hands (can be more or fewer, depending on vegetables).
- The soil from the upper/top half and the lower/bottom half of the pit should be kept separately to refill the pit.
- One basket (8–10 kg) of compost/organic manure, two handfuls (50–60 g) of TSP (Triple Super Phosphate), and one handful (25–30 g) of MoP (Muriate of Potash) fertilizer have to be mixed with the soil that was taken from the lower/bottom half of the pit.
- Then the lower/bottom half of the pit should be filled with the soil that was taken from the upper/top half of the pit.
- Then the pit should be topped/filled fully with the soil mixed with fertilizer/compost (i.e., the above soil that was taken from the lower/bottom half of the pit and kept for this purpose).
- The soil should be tilled before putting it in the pits.
- The pits then have to be covered with banana leaves or something else so rainwater does not wash away the pit or so the pit/soil in the pit does not dry up in the sun.
- It is mandatory to prepare raised pits in the rainy season, especially in the low-lying areas; however, it is not mandatory in the winter.

Topic 6. **Plantation Bed Preparation**

Steps for Preparing Planting Beds

Site selection:

- Prepare the bed at the front, back, or side of the homestead.
- Select a spot that remains sunny throughout the day.
- Make sure that the spot is not submerged or shady.
- Select a spot that will not become water logged due to heavy rain in the rainy season or the tidal effect.
- Select a spot where rain water can drain quickly.
- Select a site that is easy to access and safe to work in.
- Protect the site from cattle/goat, etc. (fencing).

Bed preparation:

- The soil in the bed should be tilled well by ploughing/spading.
- The bed should be weeded well.
- The size of the bed should be based on the available space and should be as follows: length: 8–10 hands; width: 2 hands (3 ft); and height: 1/3 hand (approximately 6 inches).
- For future crop cultivation practice, a 1-foot drain (depending on width of spade's blade) has to be made in between and around two beds. The depth should be 6–9 inches. The soil removed from the drains needs to be put on the bed since the topsoil is more fertile.

- Just before final ploughing, the land/bed has to be mixed well with compost, TSP, and MoP fertilizer.

Compost/Fertilizer dose in bed (for a bed 2 hands wide and 10 hands long):

Compost/organic manure (well decomposed): 2 baskets (15–20 kg)

TSP : 4 handfuls (100 g)

MoP: 2 handfuls (60 g)

Urea: First top dressed at 20–25 days (at the time of first weeding) – 1 handful (20–25 g)

Second top dressed at 45–50 days (at the time of second weeding or topping-up the soil) – 1 handful (20–25 g)

Topic 7. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 8. **Conclusion and Planning for Next Session**

No technical content is required. The *Farmer Nutrition School (FNS) Session Guide* is sufficient to conduct this topic.

Session 2. Sowing Seeds and Planting Seedlings in the Bed and Pit

Topic 1. **Introduction**

The seed is an important planting material, especially when properly sown in a bed or pit. A well-managed seed in a bed or a pit can provide year-round nutritious vegetables. Traditionally, many seeds are sown in a single bed or a pit, but this practice does not produce a strong yield. Successful seed sowing in a bed or a pit is critical for the 1) selection of seeds in terms of quality and season/timing; 2) preparation of beds and pits; and 3) performing the pre-sowing steps.

Topic 2. **Introduction to Breastfeeding of Children from Birth to Six Months and Diet for Lactating Mothers**

See SPRING *Community Worker Handbook*, Practices: 3. Early Initialization of Breastfeeding (p10); 4. Exclusive Breastfeeding to Six Months of Age (p11-12); 5. Diet for the Lactating Mother (p13); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. Methods of Sowing Seeds/Planting Seedlings

Steps for Sowing Seeds/Planting Saplings

In beds:

- Sowing or planting seeds and planting seedlings or saplings should be done in rows.
- The seeds will germinate best if they are soaked in water for 12–24 hours (depending on the thickness of the seed coat) before sowing.
- Six hours before sowing, the soaked seeds should be put in a rag and hung to let the excess water drip out.
- If the seeds are too small, they should be mixed with sand/ash; this will help to spread them uniformly, covering the whole area of the land.
- The seedbeds have to be sprinkled with water 12 hours before transplanting the seedling/saplings.
- It is best to plant seedling/saplings in the late afternoon or evening (so the sun does not dry up the seedlings/saplings and the soil) and water them after planting.
- If the temperature/sunlight intensity is too high, shade (with banana leaves/stems or other larger leaves) has to be provided over the seedlings/saplings for a minimum of three consecutive days from morning to afternoon (10:00 a.m.–4:00 p.m.).

The cultivation methods of different vegetables at homestead area (in bed):

Name of vegetables	Sowing/ transplanting time	Sowing/ transplanting distance (foot/inch)	Seed rate/ decimal	Life duration of vegetables	Remarks
Red amaranth	Any time of year	Whole amount broadcasted[1] uniformly	15–20 g	20–30 days	The seeds are very small, so they should be mixed with sand/ash during seeding. Fine soil needs to be put on the seeds and leveled by hand.
Kangkong	It grows year round, but it can be sown during March–April for high yield.	Line to line: 1 foot Seed to seed: 6 inches	50 g and 2–3 seeds in the hole	90–100 days	The seeds need to be soaked in water for 12 hours before sowing. When the vegetable is at the harvesting stage, cut the stem 3 inches above the soil.
Indian spinach	February–June is the best time for sowing.	Line to line: 1.5 feet Seed to seed: 1 foot (after thinning)	20–25 g	60–120 days	The seeds need to be soaked in water for 24 hours before sowing. Harvesting starts after 40 days from sowing. Cutting the dense leaves will stimulate the stems for a greater yield.
Stem amaranth	It can be sown year round, but the best time is during March–June.	Whole amount broadcasted uniformly	15 g	30–100 days	The seeds are very small, so they should be mixed with sand/ash during seeding. Fine soil needs to be put on the seeds and leveled by hand. As the plants grow bigger, the density of plant should be reduced by harvesting.
Yard long bean	March–April is the best time, but it grows year round.	Line to line: 2 feet Seeds to seed: 10 inches	40 g	60–75 days	The seeds need to be soaked in water for 8 hours before sowing. When the plant is 1 foot tall, the plants should be supported with sticks (X shaped) because of its creeping/crawling nature.
Knolkhol	September–December	Line to line: 1 foot Plant to plant: 9 inches	3–4 g	45–60 days	Seedlings are grown in a seed bed. Seedlings that are 25–30 days old are appropriate for transplanting.
Okra	It grows year round, but February–May is the best time.	Line to line: 2 feet Seed to seed: 1.5 feet	25–30 g	80–100 days	The seeds need to be soaked in water for 24 hours before sowing. The plants cannot survive in water-logged conditions.

[1] Cast or dispersed in all directions, as seed from the hand in sowing; widely diffused/scattering in all directions (as a method of sowing); -- opposed to planting in hills, or rows

Name of vegetables	Sowing/ transplanting time	Sowing/ transplanting distance (foot/inch)	Seed rate/ decimal	Life duration of vegetables	Remarks
Radish	July–December	Broadcasted or sown line to line: 9 inches Seed to seed: 5 inches	30–40 g	Leaves can be harvested 15–20 days after sowing.	Fine tilled soil (loose soil) is needed for better yields. Hard soil disturbs the growth of radish roots.

Topic 4. **Methods of Sowing Seeds/Seedlings in the Pits**

Planting Seeds or Seedlings in Pits

- Plant three to five seeds or two seedlings in each pit.
- The pit should be covered with water hyacinth (better without roots), green leaves, or hay for five to seven days after planting.
- Once the seedlings have four to five leaves after germinating, leave two healthy seedlings in the pit and remove the others to plant somewhere else. (If required, add support with a stick.)

The cultivation methods of different vegetables at homestead (in pit):

Name of vegetable	Sowing/ transplanting time	Sowing/ transplanting distance (foot/inch)	Seed rate/ decimal	Life duration of vegetables (day)	Remarks
Sweet gourd	Year round	3–4 seeds in each pit	15–20 g (6 pits/ decimal)	120–140 days	Seeds need to be soaked in water for 12 hours (overnight) before sowing in winter season. Only two healthy seedlings need to be kept in each pit, and excess seedlings need to be uprooted/planted in other empty places. A trellis is needed in rainy season, but in other seasons it can be grown on the ground/land.
Bitter gourd	Year round	4–5 seeds in each pit	25g (8 pits/decimal)	60–75 days	Seeds need to be soaked in water for 12 hours (overnight) before sowing in winter season. Only 3–4 healthy seedlings need to be kept in each pit, and excess seedlings need to be planted in other empty places. A trellis is needed for long variety.

Name of vegetable	Sowing/ transplanting time	Sowing/ transplanting distance (foot/inch)	Seed rate/ decimal	Life duration of vegetables (day)	Remarks
Bottle gourd	August–November and March–May	3–4 seeds in each pit	20–25 g (6 pits/ decimal	120–140 days	Seeds need to be soaked in water for 12 hours (overnight) before sowing in winter season. Only two healthy seedlings need to be kept in each pit and excess seedlings need to be uprooted/planted in another empty place. A trellis is needed.
Ash gourd	Year round but March–May is the best time.	4–5 seeds in each pit	2–3 g	120–130 days	Seeds need to be soaked in water for 12 hours (overnight) before sowing in winter season. Only two healthy seedlings need to be kept in each pit, and excess seedlings need to be planted in other empty places. A trellis is needed for better yield.
Country bean	July–September	2–3 seeds in each pit	25–30 g (6–8 pits/decimal)	110–130 days	The seeds can be soaked in water, if necessary; a trellis is needed.
Snake gourd	February–May	4–5 seeds in each pit	15–20 g	70–80 days	Seeds need to be soaked in water for 24–36 hours before sowing. Only two healthy seedlings need to be kept in each pit, and excess seedlings need to be planted in another empty place. A trellis is needed for better yield.
Papaya	Year round Seed sowing: 15 Feb–15 April and 15 Sep–15 Nov	2–3 seeds in each pit	3–5 g/decimal	4–5 months after transplanting	Seeds need to be soaked in water for 28 hours before sowing. Only 3 healthy seedlings (6 inches height and aged 5–7 weeks) need to be kept in each pit. Lastly, the male and weak plants need to be uprooted from the pit and only one seedling should be kept.

Topic 5. **Farm Management Analysis (FMA) On Seed Sowing and Crop Cultivation Operations**

Objective of FMA

- Develop the observational capacity of members, especially in relation to existing problem.
- Develop and/or enhance analytical capacity of the members based on the observation.
- Develop and/or enhance decision-making capacity of the members based on observations and analysis.

Four Steps of FMA

1. Observe the present situation.
2. Analyze the findings/observations.
3. Make a decision based on analysis.
4. Manage/implement the decisions.

Make the decisions based on the observations and analysis of the present situation/status of the vegetable garden. Give responsibility to the farmer for implementing the decisions.

_____ farmer nutrition school

Farm management analysis (vegetable gardening)-1:

Group Name: Date:

Observation sheet (questionnaire) for visiting the garden:

Subject of observation	Present situation/observation	Decision
Place/site of the vegetable garden		
Sunlight availability		
Soil water holding capacity		
Suitable condition of soil for seed sowing		
Weeding status		
Water logging condition		
Irrigation and drainage facilities		
Have pits been prepared? If so, were they prepared according to the rule?		
Have beds been prepared? If so, were they prepared according to the rule?		
Were fertilizers used in the pits? If so, which fertilizers and what amount?		
Were fertilizers used in the beds? If so, which fertilizers and what amount?		
Proper spacing (line to line and seed to seed)		
Thinning of sapling in pit		
Proper fencing of garden		
Trellis in cucurbits		
Scope of compost pit		
Use of mulching		
Stalking of sapling		

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required. The *FNS Session Guide* is enough to conduct this topic.

Session 3. Crop Cultivation Operations, Soil Health Management, and Compost/Manure Preparation

Topic 1. **Introduction**

It is said that a "farmer's eyes are the best fertilizer for his/her crop." Regular visits to the vegetable field, intensive observation, and protection are important for producing year-round vegetable yields from the homestead. To get a better yield, it is also important to keep plant food in the soil. The presence of required nutrients in the soil can be ensured by using compost, manure, and other organic matter. Organic manure helps keep the soil productive for a longer time, removing toxic elements, reducing salinity, and increasing water-holding capacity.

Topic 2. **Introduction to Key Essential Hygiene Actions**

See SPRING *Community Worker Handbook*, Practices: 12. Handwashing (p22); 13. Making a Tippy Tap for Handwashing (p23); 14. Keeping the Environment Clean of Feces (p24); and 15. Keeping Containers and Food Clean (p25).

Topic 3. **Crop Cultivation Operations in Vegetable Farming**

1. Fencing:

Fences protect vegetables from chicken, cattle, and goats, as well as children and walkers/passers-by. Bamboo, bamboo branches, nets, or branches of trees can be used as a fence. Justicia, croton, ipil-ipil, wild hena, vasaka, coral tree, etc. can be used as a live fence. Drumsticks can be used for the pole of the fence; the drumstick and its leaves can also be used for consumption.

2. Loosening the soil:

As seeds grow, the roots of the plant spread into the soil and the plants take in nutrients through the roots. The respiration by the roots also takes place inside the soil (from the air inside the loose soil). Therefore, the soil has to be loosened so it can retain sufficient water and air. If the soil is compact, it cannot retain water or air and thus stops the activities of microorganisms (as they also need water and air); as a result, plants do not get the nutrients in available forms.

3. Irrigation and drainage of water:

Plants cannot survive when water pools in the land or at the base of the plant. In extremely watery conditions, the young plants will die due to damping off (fungal growth in this moist environment) and lack of oxygen. Additionally, the nutrients in the soil seep down, and the plant cannot absorb them. On the other hand, lack of water in the land prevents nutrients from being available to the plants. Care has to be taken so that an optimum level of water (not too much or too little) is available.

4. Weeding:

Weeds are unexpected plants that grow around planted crops in the land. Weeds compete with the desired crop for nutrients, light, and water absorption. Therefore, they should be removed as soon as possible. Morning is the best time for weeding, since the uprooted weeds will dry in the sunlight during the remainder of the day.

5. Application of organic fertilizers on the surface:

Observe the growth/color of the crop to determine when to apply the fertilizer on the surface. The signs (growth/color) of the crop indicate what type of nutrient is deficient and thus can help determine which type of organic fertilizer to apply.

6. Gap filling:

If the seeds did not germinate in the bed/pit or any seedling has died, new seeds should be sown. Better yet, new seedlings (from another place where the plant is grown) should be planted to fill this gap.

7. Mulching:

To keep the soil moist/watery for longer periods, the land should be covered with water hyacinth (better without roots), green leaves, or hay; this process is called mulching. Mulching prevents weeds from growing and thus helps crops absorb the required nutrients. Mulching is generally done after irrigating the land.

8. Thinning of seedlings and fruit:

Plants absorb nutrients through their leaves and roots for growth and the production of fruit. The leaves and roots must have enough space to spread out and absorb the nutrients. Therefore, optimum space should be left between each plant. This space also allows room for plants to grow and produce a better yield.

In the case of crops that are grown through sowing seeds, generally seeds are broadcast densely. After the seeds germinate and seedlings begin to grow, they also start to spread their roots and branches and thus require more space. Therefore, to give seedlings more space to grow, some of the larger or stronger seedlings should be removed and planted elsewhere. The removed seedlings of many of the crops, especially the leafy vegetables, can be eaten. The remaining seedlings should have greater potential for growth. This process of removing the seedlings is known as "thinning."

Similarly, if huge numbers of fruits/vegetables (e.g., tomatoes, brinjal, pumpkin, and papaya) are on one branch or plant, they cannot grow bigger because they are not able to get enough nutrients, air, and light. In this instance, thinning is necessary and some of the fruits/vegetables (i.e., the bigger ones) have to be harvested. Like seedlings, the remaining fruits/vegetables should have a better chance to grow.

9. Pruning:

To ensure the desired physical growth of the plants, it is important to trim unnecessary branches, sub branches, leaves, and even roots; this is called pruning.

Generally, the main two branches from a little above the trunk of tomato plants should be saved, but the others have to be trimmed. Additionally, breaking or cutting the extra branches toward the base of the trunk accelerates the growth of the trunk.

Retain a few of the main trunks of certain fruits, such as watermelon, pumpkin, and gourd, and trim all the other branches. Pruning allows the plants and fruits to grow more.

10. Earthen/Topping up:

The soil of vegetable bases is generally replaced because of excessive rainfall and tidal effect, therefore extra/new soil should be put on the plant base. This also should be done when the drain of the bed or pit is cleaned and/or repaired.

11. Staking/Trellis:

For climbing vegetables, like cucurbits, it is necessary to provide support with a trellis. Some vegetables need staking when they are in the vegetative stage. A lack of proper staking results in the plants dropping onto the

ground/soil and the yield being reduced. Bamboo, bamboo branches, jute sticks, and nets are generally used to make the trellis.

12. Artificial pollination:

It usually can be seen in most types of vegetables of the gourd family that the young fruit becomes rotten and drops after flowering. An absence of insects and bees means that pollination has not happened, which results in this situation. Artificial pollination is required with these types of crops. In the early morning or in the afternoon, petals of a just matured male flower should be removed and used for pollination. The male flower needs to touch the stigma of the female flower 2–3 times for pollination. A male flower can pollinate 8–10 female flowers.

13. Regular monitoring:

Visit the vegetable gardens at least once a day. This will help you identify problems quickly and take steps to fix them.

Topic 4. **Signs and Symptoms of Deficiencies of Different Essential Nutrition Elements in Vegetable Farming**

Soil and fertilizer management:

For proper vegetative growth, flowering, fruiting, and disease prevention, vegetables and all other plants need 16 essential chemical elements throughout the growing cycle: from seed sowing to fruit production. Plants take in three of these elements—carbon, hydrogen, and oxygen—from air and water. Soil stores the remaining 13 elements.

Need of balanced fertilizer:

One or more deficiencies of the above essential elements hamper the growth of plants. Soil is generally deficient in three elements: nitrogen, phosphorus, and potassium. The soil in Bangladesh seems to lack other elements, such as zinc, sulphur, boron, and molybdenum.

Essential elements are not equally distributed in the soil, so general application of fertilizer is needed to reduce the deficiency of nutrient elements. Moreover, nutrient needs for all plants are not the same. For example:

1. Leafy crops need more nitrogen.
2. Flower- and fruit-producing crops need more phosphorus.
3. Tuber-producing crops need more potassium.

Compost/manure contains almost all of the essential 16 elements needed by plants. Moreover, organic fertilizer helps to maintain soil health and texture, increase water-holding capacity and maintain pH balance. Emphasis should be placed on using organic manure to reduce the dependency on chemical fertilizer and thus help in maintaining good soil health.

Effect of nutrients on vegetables and symptoms of deficiencies:

Through observations of some indicators, the benefit of nutrients on vegetables can easily be identified. Similarly, symptoms of nutrient deficiencies in plants are obvious; a farmer can tell when it is necessary to apply organic and/or inorganic fertilizers.

Effect of nitrogen (e.g., urea):

1. It accelerates the growth of the trunk and the branches of plants.
2. It gives the plant a deep green color.
3. It serves as an integral part of the green cells of the leaves.
4. It increases the protein in fruits and seeds.
5. It increases the production of leafy crops.

Symptoms of nitrogen (e.g., urea) deficiency:

1. The whole plant is affected. The plant looks feeble.
2. The stem and the leaves turn light green or yellow color.
3. The growth of the plant is reduced.
4. The fruits prematurely drop off.

Effect of phosphorus (e.g. TSP):

1. It contributes to cell division in plants and plays a role in photosynthesis.
2. It helps in root arrangement and growth.
3. It helps in flowering, forming/production of fruits and seeds.
4. It strengthens the trunk of the plant.
5. It helps the plant to tolerate droughts and cold.
6. It increases disease prevention capacity.

Symptoms of phosphorus (TSP) deficiency:

1. Unusual colors are visible on the leaves.
2. The base of the stem turns purple or copper.
3. The leaves grow short and fall off early.
4. Capacity to grow/produce flowers and fruits is reduced.

Effect of potassium (e.g. MoP):

1. It helps to form the green cells and protein of leaves.
2. It increases cell division.
3. It increases the number of roots through branching (secondary roots).
4. It makes the trunk solid and strong.
5. It helps grow/produce flowers and fruits.
6. It increases disease prevention capacity.

Symptoms of potassium (e.g. MoP) deficiency:

1. Some small dead spots are visible on the leaves.
2. Leaves fall off early.
3. Ability to prevent disease is reduced.

4. Flowers grow late and in smaller numbers.
5. Flowers fall off.

Method of applying organic fertilizers on land for vegetables:

1. Compost/organic manure can be applied after first tilling; TSP and MoP should be applied before the last tilling.
2. Nitrogen/Urea has to be applied on the surface in three installments: 15-20 days, 30–35 days, and 50–55 days after sowing the seeds.
3. Immediately after applying organic fertilizers, a little water has to be applied, and the soil should be loosened with hoes.

Caution in applying organic fertilizers

1. Applying organic fertilizers on the surface is harmful while the leaves are wet.
2. Nitrogen/Urea should not be applied right before irrigation.
3. Oilcakes, cow dung, lime, and bone dusts should not be applied in their raw form on the crop land.
4. Cow dung, compost, bone dust, phosphate, and ammonium sulphate cannot be applied on the land by mixing with lime.
5. Apply fertilizers 6 inches away from plant base.

Why you should use organic manure:

1. It increases the amount of organic material in the soil.
2. It increases the plant's ability to hold water and nutrients.
3. It improves the quality of the soil (soil health).
4. It works as nutrient storage for the plants, allowing the plant to use nutrients for a longer time.
5. It reduces the deficiency of sulphur and zinc.
6. It increases the air circulation and activity of the organisms in the soil. This brings the nutrients to the plants in an available form.
7. Organic manure is useful for storing humidity in the soil.
8. It increases the plant's tolerance to droughts.
9. It keeps the plant cool in the summer and helps the plant keep warm in winter.
10. Organic manure helps reduce the toxicity created by excessive use of chemical pesticides and fertilizers.

Topic 5. **Preparation of Organic Manure/Composting**

Ways to prepare compost:

- Make the pit the required size and coat the bottom with clay (generally length of three hands, width of two hands, and height of two hands).
- Around the hole, make a raised edge with soil.
- The pit has to be made so it is protected from sunlight and rain water (shed).
- It is better to have more than one chamber in these types of pits.

- In the pit, put crop residue, water hyacinth, hay, cow dung, and other waste from household (rotten leaves, ashes, and organic waste) in layers and make a heap.
- When the pit is filled, cover the top with 6 inches of a mixture of topsoil and cow dung.
- Wait for five to six weeks for compost (black fertile soil).

Importance of compost:

- It increases the fertility and water-holding capacity of soil.
- Soil becomes loose and tilled.
- It adds sufficient plant nutrients in soil.
- It increases the activity of earthworms and microbes in soil.
- The ratio of sand and salinity of soil is reduced.
- It protects against soil erosion.

Topic 6. **FMA on Soil Health Management and Use of Organic Manure**

_____ farmer nutrition school

Farm Management Analysis (Vegetable Gardening)-2:

Group Name: Date:

Observation sheet (questionnaire) for visiting the garden:

Subject of Observation	Present situation/observation	Decision
Use of organic manure in vegetable garden		
Are resources available to make organic fertilizer?		
Are fertilizers applied on soil surface? If yes, how frequently?		
Do they make compost/organic manure?		
Size of the compost pit		
Has shed on the compost pit		
Weed infestation		
Thinning of sapling		
Proper fencing of garden		
Trellis in cucurbits		
Use of mulching		
Stalking of sapling		
Artificial pollination of cucurbits		
Soil tilling		
Pruning		
Irrigation and drainage status		

Topic 7. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 8. **Conclusion and Planning for Next Session**

No technical content is required; the *FNS Session Guide* is sufficient to conduct this topic.

Session 4. Integrated Pest Management

Topic 1. **Introduction**

People are accustomed to using chemical pesticides on their crops to control pests and diseases. Local vendors prescribe pesticides and motivate people to purchase them with catchy advertisements. Often the vendor and the farmer cannot distinguish between fungicide and insecticide and do not know how to apply the pesticide without inadvertently targeting pests. As a result, the application tends to kill beneficial insects and builds resistance to the pesticide among harmful pests. Integrated pest management (IPM) is the best option to avoid the harmful use of these pesticides at little if any cost. If all FNS beneficiaries maintained IPM practices in their homestead gardens, pest attacks would be greatly reduced.

Topic 2. **Complementary Feeding For Children Ages 6–11 Months**

See SPRING *Community Worker Handbook*, Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 6-8, & 9-11 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Pests, Disease, and Integrated Pest Management**

IPM is an effective and environmentally-sensitive approach to pest management. IPM programs, combined with available pest control methods, are used to manage pest damage using the most economical means—and with the least hazard to people, property, and the environment.

Four methods of integrated pest management:

- Agronomic control
- Mechanical control
- Biological control or biological methods
- Chemical control

Topic 4. **IPM Practices and Benefits**

A. Agronomic Control Methods

- Timely and proper tilling of the land
- Sowing seeds/planting seedlings at the right distance
- Timely weeding
- Proper fertilizer management
- Proper water management
- Crop alternated cultivation/follow the intercrop system
- Planting disease and pest-tolerant varieties
- Pruning extra branches and thinning plants
- Sowing/planting disease-free and pest-resistant seeds/seedlings/saplings
- Treating seed beds
- Treating seeds

- Trimming/burning affected/dead/dried up branches
- Increasing the organic material in the soil
- Not working on the land when the leaves are wet.

B. Mechanical Control Methods

- Handpicking and destroying the eggs of insects
- Handpicking or collecting harmful insects using hand nets
- Destroying insects with light traps
- Burning or burying diseased plants, leaves, or branches
- Suspending the sticky part of jackfruit to prevent insects from breeding in the cucurbits (e.g., cucumber, melon, squash, and gourd).
- Covering fruit (e.g., pumpkins, cucumbers) with a thin rag, hay, or paper
- Making drainage around the seedbeds, notably for cabbage, cauliflower, gourd, and pumpkin seedlings (to prevent infestation of cutting bugs).

Additional notes

Insect control by traps:

There are two types of insects. Some do not like light; they live in dark areas. Others live in the bright areas and are attracted to the light at night.

Various traps for catching insects:

1. Light traps:

Insects that harm crops are generally attracted to light. If electric bulbs or hurricane lamps are switched on at night, harmful insects come close to the light and die.

Method of using light traps:

Electric bulbs, lanterns, *hajak*, or hurricane lamps can be used as traps to catch insects. Fill a pot with any kind of soap or paraffin mixed with water. Place the pot under the lamppost. When the insects fall in these pots, they will die. This method will kill a lot of harmful insects.

Make sure to place the light trap some distance from the ground, otherwise insects may move toward the light traps from surrounding areas, resulting in an increase in the number of harmful insects.

Keep the light trap on from dusk until 9.00 p.m. or 10:00 p.m., since the number of insects declines after 10.00 p.m.

2. Adhesive traps:

Mix 8 parts castor oil and 5 parts dye powder to form an adhesive solution. Apply the adhesive to a 3 X 4 inch piece of hard board or tin; install it on top of a stick; then place the stick in the vegetable field. The insects will stick to the adhesive traps and die. This trap works best in small vegetable fields.

3. Yellow paint traps:

Fill a yellow ceramic or plastic plate with a mixture of paraffin and water and place it in the garden. Aphids/white flies are attracted to the yellow color and will get stuck in the trap and die.

4. Poison bait traps:

Fruit flies, which are attracted to vegetables from the Cucurbitaceae family, can be controlled with certain pesticide baits.

Combine 100 g of ripe mashed pumpkin with 100 ml of water to make a paste. Mix 0.25-0.5 g of Sevin Powder, Dipterex, Malathion, or sobicrone with the paste. The paste should be placed in an earthen pot or coconut shell and put on a bamboo pole at 1.5 feet high. The bait in the trap is effective for two to three days in summer and for four to five days in winter. After expiry, new bait will have to be used.

5. Pheromone traps:

Insect sex pheromone is an effective method for controlling pests. Pheromone is a fluid extracted from the sex organs of female insects. This fluid attracts male insects of the same species. Using the pheromone trap, only specific harmful insects are attracted and killed. This type of trap does not harm useful insects.

In Bangladesh, the following two types of pheromone traps are typically used:

1. sex pheromone trap for pests attracted to vegetables from the Cucurbitaceae family
2. sex pheromone trap for fruit and shoot borer attracted to brinjal.

Instructions and use:

Take a 9-inch deep, 3-liter plastic jug and make two triangular holes at a height of 1.5–2.0 inches from the bottom of the jug. Each side of the triangle should be 4 inches long. Add water mixed with soap or detergent to the jug (15–20g soap/detergent in 1 liter of water). Make a hole in the lid of the jug and tie the pheromone mixed cotton bundle to the lid and hang using thin rope or twine.

The pheromone-soaked cotton should be installed 1–1.5 inches above the soapy water. The insects will be attracted to the pheromone and fall in the soapy water and die. To control fruit flies, one pheromone trap should be set up in each 2.0 decimal of land. Traps should be placed 4–5 inches above the canopy (leafy part of the plant) with a stick. Set the traps when the flowering has just begun and use until the harvest of the crops.

There are various brands of pheromones to control the brinjal fruit and shoot borer. For a 2.0 decimal garden, one trap is required. Traps should be placed 4–5 inches above the canopy with a stick. Set the traps 25–30 days after planting the saplings and use until the harvest is complete.

C. Bio Natural Management or Biological Methods

In bio natural management, heterotrophic and beneficial animals/insects, such as frogs, birds, spiders, wasps, dragonflies, ladybird beetles, and praying mantises, eat crop-damaging insects, their eggs, and larvae.

Pesticides kill these useful insects. Therefore, instead of using pesticides, steps should be taken to preserve these insects so they can multiply.

Certain insect repellent plants can be grown to help control some harmful insects (e.g., mint, tomatoes, onions, chilies, garlic, neem, and marigold).

It is also possible to control pests using homemade herbal pesticides. Research has shown that certain roots, trunks, leaves, flowers, fruits, and seeds are effective at controlling insects and diseases harmful to crops and food grains. Their effectiveness can be equal to that of chemical pesticides and they are not harmful to

humans or animals. They have no side effects and they are safe for the environment. Moreover, these types of plants are found everywhere and therefore cost less to use.

Some herbal pest control methods:

Name of herbal materials	Procedure to make pesticide	Application	Name of target pest
Neem seed/Neem leaf	Normal system: Mix 0.5 kg well crushed neem seed with 2 l of water and leave overnight. In the morning, strain using a thin cotton cloth. Then add 10 more liters of water to this solution and apply to vegetables. Boiling system: Boil 0.5 kg leaf with 2 l water. Strain using a thin cotton cloth and add 10 more liters of water. This solution is ready to apply.	Spray so that entire plant is soaked	Flies, beetles, larvae, and other adult insects
Castor apple leaf	Mix 0.5 kg well mashed leaf with 5 l water and let sit overnight. In the morning, strain using a thin cotton cloth. Then add 10 more liters of water to this solution and apply.	Spray so that entire plant is soaked	Flies, beetles, larvae, and other adult insects
Ash	Apply ash (not hot) on leaves and twigs. If the infestation is severe, then use ash mixed with kerosene.	Broadcasting	Aphid, beetle, adult insect
Detergent powder	Mix 30 g detergent with 10 l water and spray on leaves and twigs of vegetables.	Spray so that entire plant is soaked	Aphid
Tobacco	Mix 250 g tobacco leaf/stems with 4 l water and boil for 10-15 minutes. Let the solution cool; then strain using a thin cotton cloth. Add 4 more liters of water and apply.	Spray so that entire plant is soaked	Borer, larvae, aphid, termite, leaf borer

D. Chemical Control Methods

Chemical control methods are widely used in Bangladesh, but they should be avoided. **For small-scale vegetable cultivation, such as homesteading, generally, no chemical controls are needed.** If, however, natural methods prove ineffective, chemical pesticides can be used with caution and following proper

guidelines. These measures should be taken only after careful discussion with Department of Agricultural Extension (DAE) officials.

In addition, the farmer must demonstrate ability to use pesticides responsibly. For certain pests, proper dosage of the right pesticides has to be used to be effective.

Risks of using pesticides:

- long-term effect on vegetables
- long-term effect on other animals, including humans
- other organisms, including the worms and insects that help increase fertility of soil, are also killed
- environmental pollution
- useful bugs are also killed
- deadly to various animals that eat pesticide-treated crops. This also leads to environmental devastation
- high production costs
- risky to keep them in and around homes, especially where there are children.

Important instructions when using pesticides:

- Follow the instructions on the carefully.
- Write the name of the chemical clearly on the storage or application container.
- Pesticides should be placed outside the reach of children and where adolescents, poultry, cattle, and others who may be harmed by them cannot reach them.
- Only responsible and skilled persons should handle chemicals.
- Chemicals should be stored in airtight and water-resistant containers.
- Chemicals should be used in the proper dosage.
- Anyone who has open sores or scabies should not handle chemicals.
- When applying pesticides, wear gloves and a towel or mask around the face.
- Thoroughly clean hands and feet after applying pesticides.
- It is dangerous to pick, use, or eat crops within two to three weeks after applying pesticides.
- If chemicals are swallowed, consult a doctor immediately.

Making fungicide at home:

Preparation of Bordeaux mixture (1 percent strength or 1:1:100 ratio)

Materials for preparing Bordeaux mixture:

Copper sulphate ($CaSO_4.5H_2O$) = 100 g

Limestone = 100 g

Water = 10 l

Bamboo stick = 3 pcs

Earthen pot = 3 pcs (10 l capacity – 1 pcs, 5 L capacity – 2 pcs)

Procedure:

Dilute copper sulphate and limestone separately in two 5-liter pots for 2–3 hours. (For proper mixing, two different sticks should be used.) Next, in a 10-liter pot, mix these two solutions at the same speed and level and shake well with a third stick. The 10-liter solution is ready to spray on the plants.

Test:

You can tell when the solution has been properly prepared by placing a stainless steel knife in the solution and keeping it there for one minute. If the knife remains shiny, the solution has been prepared accurately. If the knife becomes pale in color, add some dissolved limestone to the solution and test it again.

Uses:

This solution should be used immediately after preparation as a wide spectrum fungicide. It protects from the diseases that cause vegetables to rot.

Precautions:

- Use the solution within 2 hours of preparation; do not store it.
- Maintain all precautions as when using chemical pesticides (it is poisonous).
- Do not apply with any kind of fertilizer or other pesticide.
- Do not apply in extreme hot temperatures or during excess rain or cloudy weather.

Topic 5. **FMA on Use of Integrated Pest Management versus Traditional Techniques**

_____ farmer nutrition school

Farm Management Analysis (Vegetable Gardening)-3:

Group Name: Date:

Observation sheet (questionnaire) for visiting the garden:

Subject of Observation	Present situation/observation	Decision
Vegetables affected by insects		
Vegetables affected by diseases		
Presence and number of beneficial insects		
Presence and number of harmful insects		
Using proper plant and line spacing		
Condition of drainage system		
Sunshine availability in the garden		
Use of any mechanical method to control pest		
Using pheromone trap to control fruit fly		
Use of any biological method to control pest		
Using any plant leaf/plant body to control pest		
Use of any chemical method to control pest		
After using the chemical when consuming vegetable		

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 5. Seed Production, Collection, and Storage

Topic 1. **Introduction**

Vegetable seed production has long been practiced in Bangladesh. But now, farmers are becoming more dependent on packet seeds, which are available in the market and are sold by different companies. All companies and even all seeds of the same company do not produce the same crop yield. Moreover, seeds in local shops are often adulterated. Therefore, it is important for farmers to learn seed production, processing, and preservation, especially so that women can grow year-round nutritious vegetables in homestead gardens.

Topic 2. **Complementary Feeding For Children Ages 12–24 Months**

See SPRING *Community Worker Handbook*, Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 12-24 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Selection of Quality Seeds**

Definition of Good Seed

Good seeds have high germination rates and are collected from pure species. They must also meet the following conditions:

- The species should be pure, and the yield should be more than 95 percent.
- The seeds should be certified. The source of the seeds should be trustworthy (whether it is from the farmer or any other source, e.g. Seed Company).
- The quality of the seeds should be improved/high yielding.
- The seeds should be free from pests and have no scratches on them.
- They should be of equal size, in good shape, and the average weight of well-developed and equally matured seeds.
- The color of the outer skin should be shiny or bright and clean.
- The seeds should not have any bad odor.
- At least 80 percent of the seeds have to be germinated.

Difference between Good and Poor Quality Seeds

Good seeds	Poor quality seeds
Well matured and dry. When pressed with something hard, they should make a "crack" sound.	Immature and may not be well dried. No sound is made when they are pressed with something hard.
The smell of the seed is normal and color is bright.	Seeds are odorous or less fragrant and pale.
If the seeds are put in water, the good seeds will sink to the bottom.	Bad seeds will float.
They are free from insect infestation and/or diseases.	They are affected by insects and/or diseases.
All seeds are the same size and from same variety.	Seeds are of different sizes and mixed with different varieties.
The seeds are clean and dust and weed free.	The seeds are unclean and mixed with dust and weed seed.

Additional information:

Generally two types of seeds are used:

- Free/open pollinated seeds
- Cross or hybrid

Usually, when the stigma of the female flower comes in contact with the male flower, seeds are produced. The process of mating is called pollination. Pollination is done in two ways:

- Natural or free pollination
- Artificial pollination

Free/Open Pollinated Seeds

These are usually collected from the crops produced by natural pollination (through air, insects, birds, water etc.).

Cross or Hybrid Seeds

New varieties or cultivars can be developed through artificial pollination. New varieties can be obtained through cross breeding, whereby one variety of male flower is mated with another variety of female flower. The seeds collected from the crops produced in this way are called crossed seeds. Hybrid seeds are a type of crossed seeds that are stronger, improved, and of better quality than their parent plants.

The production of hybrid seeds is much higher than the production of normal seeds (freely pollinated seeds). However, crossed breed/hybrid seeds are usually more expensive than freely pollinated seeds.

Other seed categories include:

High-yielding seeds:

High-yielding seeds refer to the seeds of those species that have a higher production capacity or yield.

Improved seeds:

Improved seeds are those seeds that do not stem from high-yielding species, but are instead collected from the best local varieties of plants grown (vegetables, fruit, etc.).

Topic 4. **Collecting and Storing Seeds**

Collection: The mother plants have to be selected before collecting the seeds. Plants from at least two rows or four cubits away from the ridge should be selected; this way, cross-pollination occurring with other species is avoided. This method retains species purity.

Only mature seeds should be collected. Typically, 80-90 percent of seeds must be mature for collection to be effective.

Fruit selection: It is very important to select the right fruits for seeds. The fruit should be of optimum size and with no scratches. The fruit can be covered with a perforated polythene or a very thin cotton cloth to avoid scratches.

Processing: Processing refers to threshing the collected seeds (if required), cleaning, treating (if required), and later packing for selling or storing.

Cleaning and grading: The seeds need to be cleaned after collection or threshing. The hay, small pods, and undesired species must be removed using husking fans or sieves. Next, seeds of similar size and average weight must be separated.

Drying: Seeds should not be dried on the ground. They can be dried on mats, *hoglas*, or plastic sheets. Seeds should not be dried in the sun initially, but if necessary, seeds can be dried in the sun for three to eight days, especially in the wet season. It is best to dry them from 10:00 a.m. to 3:00 p.m. Press a seed with a hard object to test whether it has been dried well. If it produces a "crack" sound, it is dry. Dried seeds must be cooled to room temperature before they can be stored.

Storing of seeds: Store seeds in a dry, dark, and cool place. Different types of pots can be used, such as tin containers with lids, colored glass bottles, polythene, drums, or earthen pots. Regardless of the type, all pots must be airtight. Examine the seeds from time to time by opening the container. Put a hand inside the pot to feel whether it is warm or moist inside. If you feel warmth or moisture, the seeds will have to be dried again in the sun. After cooling, store the seeds again. Dried neem leaves can be used to prevent pests. Additionally, locally available appropriate technology can be used, such as charcoal or puffed rice.

Nowadays, it is very popular to use dry sand to store seeds with dry neem leaf. First, put some sand and neem leaves in the storage cans. Next, add the seeds (separate with thin cotton if more than one seed variety is present) and fill the rest of the space with a mixture of dry sand and neem leaves.

Testing quality: Whether farmers use the stored seeds or sell them, they should understand how to assess the quality of the seeds. Before sowing, the quality should be tested using the aforementioned table, entitled "Difference between good and poor quality seeds."

Seed quality check: Quality can also be assessed by examining the external appearance of the seeds (e.g., the color, size, shape, whether they are pest stricken, smashed, underdeveloped, broken, smelly, etc.)

Humidity check: For proper germination, the seeds should contain 10 percent to 12 percent water.

Since humidity-measuring instruments are not available at the local level, the farmers can assume that the seed is containing desired humidity level if the seeds make a "crack" sound when broken (generally by teeth).

Purity check: A sample (150-200 g) of seeds should be taken to check the purity. The sample should include seeds of all types, sizes, species, and other materials. Among the samples, pure seeds, seeds of other species, and other unwanted particles have to be separated and weighed. Dividing the weight of each part with the total weight of the samples will give the rate of pure seeds. The number of samples can vary depending on the number of seeds.

Checking the germination rate: To check the rate of germination, take four earthen plates full of wet, fine granule sand and evenly spread 50–100 seeds across them. Cover the plates with a 1 cm deep layer of wet sand. Periodically, apply water to prevent the seeds from drying out, but do not drown them. Mark each to avoid mixing them up. After 5-6 days, germination should occur. To calculate the rate of germination, divide the number of healthy, normal seedlings by the total number of seeds on the samples and multiply by 100. This calculation can be done directly on a farmer's land by sowing the germinated (soaked for 2-12 hours) seeds in the pits or beds; the germination can then be calculated when seedlings sprout from the seeds by a simple process of counting how many have sprouted.

Additional Note

Seed collection from gourd family:

A. Fruit remains fleshy after ripening: Seeds should be collected from normal, healthy, and ripe fruits. After separating the ripened fruits from the mother plant, store them in a shady and cool place for five to seven days. Then cut the fruit lengthwise and pick the seed by hand. The seeds should be collected from the middle part of the fruit. Wash the seeds rapidly with clean water to remove the immature seeds and the flesh. Next, dry the cleaned seeds in a shady place for one day and then gradually relocate to a sunnier place (sun dry) for three to four days. When the seed moisture level has reached 8-10 percent, they can be stored in an appropriate container.

B. Fruit becomes dry after ripening:

When attached to the mother plant, after ripening, the fruit's skin turns very hard and spongy. The color turns from green to ash; the entire fruit is then collected and hung in a room, generally in the kitchen. The seed is preserved inside the fruit until the next season (this is a traditional way to preserve seeds in Bangladesh).

It is best to collect ripened seeds from the dry fruits, dry them in the sun for one day, and then store them in an improved container (e.g., ribbed gourd, snake gourd).

Seeds collected from red amaranth and stem amaranth:

Rub the inflorescence of the amaranth with the palm of your hand. Collect any black seeds that come out. When approximately 80 percent of the seeds are ripe, cut the whole plant and place it in a light, sunny place. Next, thresh the crop well and winnow with a hand winnowing fan to collect the seeds. Then dry the seeds in a sunny place for two to three days before storing in a sealed container.

Seeds collected from okra:

When the fruit's color turns from green to ash, it is time to collect the fruit for seed collection. It is best to collect fruit from the third and fourth nodes of the plant for better yield and to ensure the quality of the seeds. Collected fruit should first be dried in a shady place and then moved to a sunny place. Once the fruit becomes cracked, the seeds can be collected. The seeds are then dried in a sunny place and stored.

Seeds collected from yard long beans and country beans:

Yard long beans and country beans ripen gradually. When the fruit becomes yellow, it is ready to be collected. First, dry the fruit in a sunny spot. Next, break the fruit by hand to collect the seeds. Then dry the seeds again in a sunny place. Separate the immature, pale seeds and store the rest in a container.

Seeds collected from Indian spinach:

When the fruit turns a blackish maroon color and the twigs turn yellow, it is time to collect the fruits. Separate the fruit from the twigs; then dry the entire fruit in a sunny place. Do not rub the fruit because the seed coat may rupture. Dry the seeds for at least five days. When the seed coat turns black, store the seeds in an airtight container.

Seeds collected from kangkong:

In the Bengali month of Falgun (mid-February to mid–March), the fruits and plants are collected and dried in the sun for three to four days. Then thresh them well with a stick and collect the seeds. Dry the seeds in the sun again for three to four days before storing in a container.

Topic 5. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 6. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 6. Essential Nutrition Actions and Essential Hygiene Actions

Topic 1. **Introduction**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 2. **Key Messages and Practices of Essential Nutrition Actions/ Essential Hygiene Actions**

See the SPRING *Community Worker Handbook*, Section 1. Key Essential Nutrition Actions (p7-19) and Section 2. Key Essential Hygiene Actions (p21-25).

Topic 3. **Group Work**

The technical content referenced above should be used to conduct this topic.

Topic 4. **Session Evaluation and Review**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 5. **Conclusion and Planning for Next Session**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Module 2: Native Chicken Rearing

Session 1. Basic Techniques for Local Chicken Rearing

Topic 1. **Introduction**

Native (or local) chickens reared in free-range backyards or semi-scavenging conditions help people of various classes and professions meet their nutritional needs and generate income. Most markets accept a higher price for local eggs and chickens, as opposed to broiler chickens. Rearing native chickens has some advantages: mother hens (broody hen) incubate the eggs and hatch the chicks by themselves; mother hens provide heat (brooding) to their newly hatched chicks; and the egg-laying production cycle can be increased two to three times through improved rearing practices, which are described in this chapter. These improved practices, described below, can have a dramatic increase in food production when compared to traditional practices.

Topic 2. **Introduction to Diet for Pregnant Women**

See SPRING *Community Worker Handbook,* Practices: 1. Diet for Pregnant Women (p8); 2. Iron Supplementation during Pregnancy (p9); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Improved Management in Increasing Chicken Egg Production**

Importance of Native Chicken Rearing

- Chicken meat and chicken eggs are the cheapest source of animal food.
- Chicken eggs are an ideal food for the ill, pregnant and lactating women, and young children.
- Chicken meat and eggs provide nutrients that contribute to the normal growth of the fetus during pregnancy and can improve the physical condition of children.
- Chicken liver reduces blood deficiencies in women.
- Chicken rearing increases family access to chicken meat and eggs.
- Surplus (after personal consumption) production can be sold, providing income to women.
- Women can easily rear local chickens on the homestead.
- Native chickens are ideal for reproduction on the homestead.
- Native chickens are immune to some common diseases and parasites.
- Native chickens are hardy and can survive harsh conditions.

Importance of Improved Management In Rearing Native Chickens

- The use of the improved brooding pot ensures continuous and uniform heating and thus hatching rates increase.
- Survival rate of chicks can be increased from 30 percent to 80 percent.
- Using the improved methods, through hatching eggs by the same hens, the production cycle can be much higher (up to five to six more cycles).
- Chicks are hatched at the same time (or with little time difference between hatching), which facilitate making a good vaccination plan.
- By combining vaccination plans with neighbors, farmers with small flocks can access vaccines at more affordable rates.

Basic concepts of the egg production cycle of native chickens:

A production cycle refers to the period that starts with laying eggs, then hatching the eggs (brooding time), and ends when the laying egg process starts again. In traditional practices, a hen lays eggs two to three times a year. Through better management and improved techniques, however, a hen can lay eggs five to six times a year. This means that using improved methods can nearly triple profit and yield.

Production cycle of local chickens using traditional methods	**Production cycle of local chickens using improved methods**
Period of laying eggs: 22 days on average (20–24 days) ↓ Incubation of eggs (brooding time): 21 days ↓ Rearing chicks with mother: average of 85 days (80–90 days) ↓ Again starts laying eggs Total time= (22+21+85)= 128 days Total annual production cycle is about two to three times a year.	Period of laying eggs: 22 days on average (20–24 days) ↓ Incubation of eggs (brooding time): 21 days ↓ Rearing chicks with mother: average of 13 days (10–15 days) ↓ Preparation for next egg laying cycle: average of 12 days (10–15 days) ↓ Again starts laying eggs Total time= (22+21+13+12)= 68 days Total annual production cycle is about five to six times a year.

Topic 4. **Separation of Chicks from the Mother (Broody Hen)**

Separating Chicks from the Mother

The mother (broody hen) should be separated from the chicks when the chicks are 10–15 days old in the winter season and 3–4 days old in the summer season. After separating the mother, she should be kept out of sight of the chicks and should be provided with 60–70 g of formulated feed (layer) per day, so she gains weight and is prepared to start laying eggs again soon. Broiler feed should be provided to the chicks since this will accelerate their growth.

Vaccination and Medication

Vaccination:

1. When chicks are 3–7 days old, they have to be provided with BCRDV vaccines in the eyes; after 20–21 days, they are given a booster dose (2nd dose) of BCRDV.
2. In the winter season or season of pox, pigeon pox vaccine should be provided when the chicks are 10–14 days old. If the pigeon pox vaccine is unavailable, fowl pox vaccines should be provided at 1 month of age.
3. Additionally, the first dose of RDV vaccines should be given at the age of 2–2.5 months, and the second dose of RDV should be given at 4 to 5 month intervals.

Medication:

1. To make the 3 to 4 day-old chicks stronger, feed them a solution of 0.5 g of Renamycin/tetracycline antibiotic, 0.5 g multivitamin (water soluble [WS]), 10 g sugar/50 g of glucose, and 1 g vitamin C (in summer) mixed with 1 l water.
2. For prevention of blood dysentery/coccidiosis, chicks that are 10–15 days old have to be fed with 1–1.5 g ESB_3, Coccicure, or any other antibiotic mixed with 1 l water for 3–5 days. If necessary, consult a veterinarian.

If the chicks show symptoms of sickness or restlessness, consult a veterinarian.

Topic 5. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 6. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 2. Improved Housing and Laying Hen Management

Topic 1. **Introduction**

Housing is very important for poultry rearing management. Poultry houses or coops can be constructed with low-cost, readily available materials, such as bamboo, betel nut tree stem, wooden planks, nylon thread, polythene sheets, etc. Coops should have enough space for the chickens to live comfortably and allow them room to flap their wings, walk about, and build comfortable nests. Chicken coops must be hygienic and feature changeable flooring (like sawdust, woodchips, or sand), ventilation, and room for humans to move around and clean them. A good coop will provide the birds with shade and shelter and protect them from draughts and rain. Laying hen management is very important for increasing egg and meat production. Balanced feed and clean water should be supplied during the laying period.

Topic 2. **Introduction to Breastfeeding of Children from Birth to Six Months and Diet for Lactating Mothers**

See SPRING *Community Worker Handbook,* Practices: 3. Early Initiation of Breastfeeding (p10); 4. Exclusive Breastfeeding to Six Months of Age (p11-12); 5. Diet for the Lactating Mother (p13); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

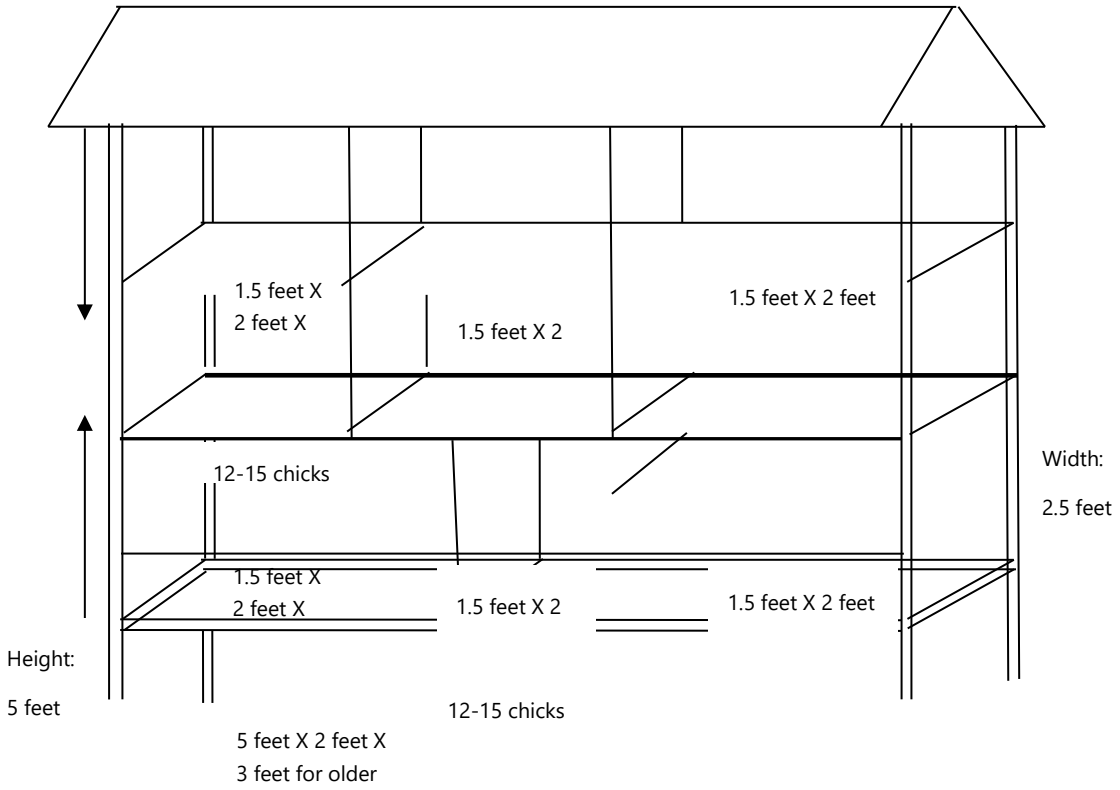
Topic 3. **Improved Housing System for Native Chickens**

Improved Housing for the Raising Of Native Chickens

A good chicken coop protects birds from bad weather, predators, physical injury, and theft. A coops must also provide a stable environment in which the birds feel "comfortable" both during daytime and nighttime temperatures. The coop should also have secure nesting boxes and enable the birds to grow, sleep, and lay eggs in comfort, free from stress and disease. These conditions help increase the production of birds and eggs.

How to build a multitier shed/coop:

To make a simple coop, spread hay across the ground and place a dry sack of cloth on top. Next, enclose the chicks and the mother hen in a cage (generally made of bamboo or used fishing net) so that predator birds (e.g., kites and crows) and animals (e.g., dogs, jackals, and cats) cannot reach them. Keep the chicks and the mother in this cage and provide them with feed and water. A separate coop can also be made to raise the chicks. Locally available materials, such as bamboo, wood, hay, fishing net, and a strip of betel nut/palm can be used, as well as timber. For each coop, a hen should have at least 1.5–2 square feet of space and there must be 0.5 square feet for every chick. For example, if you are making a shed for 20 chicks and 6–7 chickens, the house must be 4 feet long, 2.5 feet wide, and 3.5 feet high. A double-tiered house is preferable. The top of the shed can also be made with roofing grass or rice hay covered with polythene to protect it from monsoons.



Sample of a multitier shed

Topic 4. **Improved Methods for Raising the Laying Hen**

1. Feeding and drinking water system for laying hens:

Maintaining the health and weight of laying hens, especially during brooding, is important for ensuring that they lay eggs at the right time. For a balanced diet, feed each chicken 60–70 g of layer feed (available in the market) and 15–25 g of homemade feed daily. In addition to those two types of feed, feed the chickens sliced vegetables for better growth. Provide each chicken with 150–200 ml of clean drinking water each day and allow the hens at least 5–7 hours to scavenge.

2. Vaccination or drug/vitamin supply:

Every 4–5 months, hens have to be vaccinated with RDV. Periodically, give the chickens 0.5 g vitamins (Renavit WS) and 0.5 g Renamycin/light dosage of antibiotic mixed in 1 l of water for 2–3 days as a preventive measure. Every 3–4 months, feed the hens vermicides. A solution of 2–2.5 g Aviper/Poulnex/Ascarex or other deworming medicine mixed with 1 l water will work for 10 to 14 old hens. For better results, feed the hen any kind of multivitamin the day before, the day of, and the day after deworming.

3. Making an egg-laying nest (if possible):

For every five hens, there needs to be one egg-laying nest. The circular nest (like a bowl) should have a 12-inch diameter at the upper portion, a depth of 6 inches, and a diameter of 10 inches at the bottom. The nest/pot can be made with clay, bamboo, or wood and should have a layer of hay or wood dust at the bottom. It should be placed in a quiet, dark place.

4. Cock rearing:

To obtain fertile eggs from the laying hens, there must be one healthy native cock for every 10 hens. Cocks need 70–80 g of a balanced diet and homemade feed every day. They also require clean water, regular deworming, and vaccination.

5. Other management notes:

- Older hens will lay fewer eggs, so these laying hens should be replaced every year by younger ones.
- Keep chicken coops clean and germ-free.
- Make sure to trim the adult chickens' beaks every 14–16 weeks to prevent fighting.
- Lastly, adding seasonal vegetables to the feed can yield good results in maintaining chicken health and thus egg production.
- Topic 5. Farm Management Analysis on Poultry Shed: Improved Versus Traditional

Farm Management Analysis (FMA)

Objective of FMA:

- Develop the capacity of FNS members to detect problems through observation.
- Develop and/or enhance analytical capacity of FNS members.
- Develop and/or enhance decision making capacity of FNS members.

The four steps of FMA:

1. Observation
2. Analysis
3. Decision
4. Management/Implementation

Make decisions based on observations and analysis of the situation/status of the chicken coops. Give responsibility to the farmer to implement the decision.

_____ farmer nutrition school

Farm Management Analysis-1 (Hen rearing)

Group Name: Date:

Farmer Name:	Number of large chickens:
Number of medium-sized chickens:	Number of chicks:
Drawing Picture: Chicken coops, roof of coops, shed of coops, condition of floor and picture of its environment, etc.	

Observation sheet (questionnaire) for visiting the farms:

Subject of Observation	Present situation/observation	Decision
Availability of sufficient air and light in the coop		
Space for each hen		
Condition of floor		
Is the coop hygienic?		
Use of feeder and drinker		
Height of floor from land		
Condition of roof		
Are the chickens and ducks kept separately?		

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 3. Broody Hen Management

Topic 1. **Introduction**

A hen that is prepared/ready to hatch chicks is known as a broody hen. Broodiness involves a hen sitting on her eggs for the purpose of hatching. A broody hen typically has increased body temperature and exhibits the following behaviors: reduced intake of food and water, frequent nest occupancy, turning and retrieval of eggs, aggressive or defensive behavior, characteristic clucking, and cessation of egg production.

Traditional practice does not provide proper care for the broody hen. By the traditional method, incubation happens in a bamboo basket and does not take into consideration the number and weight of eggs (capacity of the hen). It also does not require feed and water to be placed in the hatching pot. Consequently, the egg-hatching rate tends to be lower than for the improved method and the hen is less physically prepared for the next egg-laying cycle.

In an improved hatching pot (*hajol*), on the other hand, the number and weight of eggs are calculated according to the body weight of the hens, which are provided balanced feed and clean drinking water. This method results in a much higher egg-hatching rate. The broody hen will lose minimal body weight and therefore will require less time between egg-laying cycles.

Topic 2. **Introduction to Key Essential Hygiene Actions**

See SPRING *Community Worker Handbook,* Practices: 12. Handwashing (p22); 13. Making a Tippy Tap for Handwashing (p23); 14. Keeping the Environment Clean of Feces (p24); and 15. Keeping Containers and Food Clean (p25).

Topic 3. **Selection of Broody Hens and Eggs for Hatching and Management Practices During Incubation**

1. Selection of hens:

Generally, a hen is capable of incubating a number of eggs equal to half of her body weight. Therefore, the larger the hen, the more eggs she can incubate. The following table shows the egg weights for different sized hens.

Type	Breed	Weight (grams)
Local	Hen	30–32
Improved	Hen	40–42
Commercial	Hen	55–60
Local	Duck	50–55
Improved	Duck	55–60

One should also consider the health history, fitness, egg-laying issues, and vaccination history before purchasing or collecting a hen. An egg-laying hen can be used for a maximum of two years for optimal production.

2. Selecting eggs for hatching and caring for the eggs:

a. Egg size:

Eggs that are too small or very large should not be selected for hatching. Eggs that weigh approximately 32 g are universally accepted. Eggs with a 2:1 ratio of white to yolk have the highest rate of hatching. Eggs of unusual size should always be discarded.

b. Shell color:

Generally, white eggs are used for hatching. Eggs with stains should be avoided. If using brown-colored eggs, medium or deep brown eggs tend to hatch better than light brown ones.

c. Shell texture:

If the quality of the shell is low due to calcium or vitamin D deficiency, the eggs are less likely to hatch.

d. Cracked shell:

Eggs can be checked for cracks through a sound test. Tap the egg gently and if it makes a blunt sound, it is cracked; a sharp sound indicates an un-cracked/good egg.

e. Care of eggs during transport:

Eggs should be kept steady during transport and handling, otherwise the amount of air in the shell will increase, resulting in reduced hatchability.

f. Dirty (soiled) eggs:

The soil/dirt on the eggs must be cleaned with a clean cloth, knife, or other material, but never with water. Water will cause germs to attack the egg, which will result in fewer chicks hatching. Never use an egg with too much soil on its body.

g. Age of egg:

The eggs for hatching can normally be kept for 3 days in the summer and 7–10 days in the winter. However, if the eggs are stored in a safe and cool place, 7–10 days in the summer and 10–15 days in the winter are acceptable periods of time to yield good results.

h. Influence of the male:

For the best results, eggs should be collected from farms where the ratio of the cock to hen is 1:10 and from farms that have good, strong, and healthy cocks. Eggs produced without mating with the cock will not hatch.

3. Making an improved *hajol* for incubation:

Improved *hajols* are bigger than the traditional ones. The approximate measurement has to be 10 inches X 7 inches X 14 inches (i.e., the upper diameter 14 inches, bottom diameter 10 inches, and the height 7 inches). This size allows the hen to heat the eggs equally and to move around more easily, resulting in a higher rate of hatching.

At the bottom of the *hajol*, make a 1 inch layer of wood dust or ash and a 2–3 inch layer of hay; put a small amount of neem leaf or, if unavailable, 1–2 small pieces of naphthalene inside the *hajol* and then place the hen inside. The *hajol* should fit tightly on the floor, so that it does not turn over when the hen moves.

4. Number of eggs and period of placing:

A hen can incubate eggs equal to half of her body weight. This means that if a hen weighs 1,500 g or 1.5 kg, she can incubate 25 local chicken eggs, 15 duck eggs, or 20 Sonali or Fayomi chicken eggs. Usually, if eggs are laid in the evening, the chicks will hatch after a full 21 days. The mother can heat up the chicks the whole night and in the morning, healthy, strong chicks will hatch.

5. Effect of temperature, air circulation, and humidity:

The ideal temperature for incubation is 99°F to 101°F. If the temperature is too low or too high, it will increase the mortality rate of the embryos inside the eggs or the chicks that hatch. Insufficient air circulation will also increase the mortality rate. For hatching, 70 percent humidity is required. For chicken eggs, the humidity must be between 50 percent and 60 percent during the first 18 days and between 65 percent and 70 percent during the last 3 days, otherwise chick mortality will increase. If the humidity is less than required, wipe the eggs with a clean and wet cloth/towel while keeping the hen outside of the *hajol*. The frequency of wiping depends on the amount of humidity as per the below table.

Amount of humidity	How many times to wipe
30–40%	4 times a day
40–50%	3 times a day
50–60%	2 times a day
60–70%	1 time a day

6. Candling or checking eggs:

Seven to fourteen days after putting the eggs on the *hajol*, check the status of hatching. If it is dark, you can use can shine a flashlight on the egg to see the inside. If there is a red vein inside the egg, it is suitable for hatching. If there is a black spot inside the egg, it is not suitable for hatching but it is still suitable for human consumption.

7. Storing eggs:

Hatching eggs should generally be stored between 50°and 55°F. If the temperature is excessively cold or hot, the quality of the eggs cannot be maintained.

8. Influence of the cock:

For the purpose of hatching eggs, 1 good cock is needed for 10 hens (ratio of 1:10); otherwise, no or limited hatching will occur.

9. Feeding and drinking water schedule for broody hen:

A balanced diet is important to maintain the health and prevent weight loss of a broody hen. Everyday provide the hen with 20–30 g of layer feed (formulated feed available in the market) and 10–20 g of homemade feed. In addition, sliced vegetables should be supplied for optimal growth. Every day, supply the broody hens with 40–60 ml of clean drinking water.

Topic 4. **FMA on Brooding Nest: Improved Versus Traditional**

_____ farmer nutrition school

Farm Management Analysis-2 (Hen rearing)

Group Name: Date:

Farmer Name:	Number of broody hens:
Number of incubating eggs:	Number of chicks:
Drawing Picture: *Hajol*, incubating materials, position of *hajol* and picture of its environment, etc.	

Observation sheet (questionnaire/checklist) for visiting the farms:

Subject of observation	Present situation/observation	Decision
Weight of hen		
Number of eggs for incubation		
Condition of eggs		
Materials needed at the time of incubation		
Water and feed supply at the time of incubation		
Time of incubation		
Position of *hajol*		
Candling of egg		
Weight of mother hen		

Topic 5. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 6. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 4. Chick Rearing Management

Topic 1. **Introduction**

In traditional practice, chicks remain with their mother for two to three months. Since they scavenge in the open, chicks are susceptible to various diseases and predators. As a result, few grow to maturity. With improved methods, the mother hen is separated from the chicks when the chicks are 3–4 days old during the summer season and 10–15 days old during the winter season. After separation, brooding, feeding, watering, and vaccinations have to be done properly to reduce the mortality rate of chicks. A small number of chicks (10–15) can easily be fostered under a broody hen at night. But for a large number of chicks, artificial brooding is necessary.

Topic 2. **Complementary Feeding for Children Ages 6–11 Months**

See SPRING *Community Worker Handbook*, Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 6-8, & 9-11 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Poultry Shed/Housing and Brooding Chicks**

Housing Chicks

For the first 5-6 hours after the chicks hatch, they must remain with their mother so that the heat of the mother's body keeps them healthy and strong. The eggs must be placed in the *hajol* in the evening, so they hatch during the evening and stay the whole night with their mother (since the mother will not go out in the night). If the chicks hatch in the morning, they risk dying more easily, as they may lose warmth when the mother hen leaves the *hajol* (e.g., for defecation).

A well-made coop/shed can reduce chick mortality significantly. Chicks can stay in the coop both day and night, providing both "comfort" and protection from predators. During the daytime, hay must be spread on the ground and dry sackcloth placed over the hay before the chicks and mother can be placed in the coop/shed. The coop should be covered with a wicker basket to keep out kites, crows, dogs, iguanas, and other predators. The chicks and mother should be given feed and clean drinking water. Some extra hay should be placed inside the covering basket where the mother and chicks are kept.

A separate coop can be made to rear additional chicks, especially during the daytime. It can be constructed with locally available materials, such as bamboo, wood, hay, cotton/fishing nets, and strips of betel nuts tree. The coops should provide 0.5 square feet for each chick.

Brooding Chicks

During the first month of life, chicks are unable to maintain their body temperature by themselves, so they are at risk when it is cold. To overcome this problem, proper temperature needs to be maintained during the brooding period. According to the traditional method, the chicks receive heat from broody hens. In the improved method, artificial methods are used to ensure proper brooding time for the chicks after separation from their mother. Brooding time depends on the season. In the summer, it lasts between two and three weeks, whereas, in the winter, it lasts from four to five weeks. In the winter, 2–3 100 watt bulbs per 100 chicks and in the summer, 1–2 100 watt bulbs per 100 chicks will provide sufficient warmth. In areas without electricity, a kerosene lantern will work. One kerosene lantern is needed for 25 chicks. Rice husks, wood powder, ash, or sand can be used as litter in the chicks' coop. This litter material should be stirred from time to time. The chicks have to be kept in the coop until they are one month old, at which point they can be freed and can adjust to the environment.

Topic 4. **Feeding and Drinking Schedule for Chicks**

Elements of Feed

- **Carbohydrates:** Feed containing carbohydrates provides heat energy. Excess carbohydrates are converted to fat and stored in the body. Corn, wheat, rice grains, rice husks from automatic mills, etc. contain huge amount of carbohydrates.
- **Protein:** Protein helps animals accelerate growth and enhance egg-laying capacity. Proteins are made up of amino acids and can come from various types of oilcakes (e.g., sesame oilcake, peanut oilcake, and sunflower oilcake), soybean meal, meat and bean meal, fishmeal, meat meal, blend meal, entrails, crushed snails, and oysters.
- **Lipids or Fats:** Fats are an important source of energy. They contain 2.25 times more energy than carbohydrates. Moreover, fat makes the meat tasty and keeps the feathers shiny. Fats also help control body temperature. Plant and animal oils are the best types of fats.
- **Vitamins:** Vitamins keep the body healthy and strong and reduce malnutrition. Two types of vitamins exist: a) vitamins soluble in fats (e.g., vitamins A, D, E, and K); and b) vitamins soluble in water (e.g., vitamins C and B complex). Vegetables, crop grains, cod liver oil, and poultry feed are sources of vitamins.
- **Minerals:** Inorganic materials are minerals that help balance the ratio of acidity and alkalinity. They help build bone structure, shells, and blood. Crushed bones, fish bones, crushed snails and oysters, eggshells, limestone, and salt are the best types of minerals.
- **Water:** Water makes up 85 percent of the body of a 1-day-old chick, 55 percent of an adult chicken, and 73 percent to 74 percent of meat and eggs. Poultry feed contains roughly 10 to 12 percent water. The rest must come from potable water.

Feed and Drinking Water Schedule:

Daily feeding schedule for local chicks

Age (month)	Age (week)	Quantity (grams/chick/day)	Remarks
	1	8	Every chicken has to be provided with twice as much water (cc/ml) as their feed.
	2	12	
	3	15	
1 month	4	20	
	5	22	
	6	25	
	7	30	
2 months	8	35	
	9	38	
	10	40	
	11	43	
3 months	12	45	
	13	48	
	14	50	
	15	53	
4 months	16	55	
	17	57	
	18	59	
	19	61	
5 months	20	64	
	21	65	
	22	66	
	23	68	
6 months	24	70	

Rules for Providing Daily Feed for Native Chickens

A one-week-old chick requires 8–10 g of broiler starter feed. At each additional week, 5–7 more grams of broiler starter feed should be supplied per bird. Starting at 4 weeks, homemade feed (rice grains, rice husks, lentil bran) should be added to this feed, gradually increasing the amount little by little. If the chicks are underfed during this time, their physical growth will be hampered.

Typically, chicks require twice as much water as feed. Therefore, it is important to maintain a continuous supply of clean drinking water.

Mix 0.5 g Renamycin, 0.5 g water-soluble vitamins, and 10 g of sugar in every liter of water to make a solution, which should be fed to the chicks for 3–4 days by pouring it little by little in the drinker.

One plastic drinker is needed for every 20–30 chicks. In the first month, the capacity of the drinker should be 1 liter; in the second month, the capacity of the drinker should be 2–3 liters. During the first and second months, 20–30 chicks will need to eat from a 1.5 kg feeding tray.

Starting at 21 days old, chicks have to be provided with broiler grower feed. An adult local chicken has to be supplied with 60–70 g (daily) for a balanced diet, but a good yield can be achieved if more feed is provided from natural sources.

Topic 5. **FMA on Chicken Coop: Improved Versus Traditional**

_____ farmer nutrition school

Farm management analysis-3 (hen rearing)

Group Name: Date:

Farmer Name:	Number of large chickens:
Number of medium-sized chickens:	Number of chicks:
Drawing Picture: Chicken coops, roof of coops, shed of coops, condition of floor and picture of its environment, etc.	

Observation sheet (questionnaire) for visiting the farms:

Subject of Observation	Present situation/observation	Decision
Place where chicks are kept		
Protection of chicks		
Floor space according to number of chicks		
Use of feeder and drinker		
Lighting system		
Feeding and watering system of chickens		
Vaccination		
Percentage of hatchability and when		
Weight of mother hen		

Topic 6. **Session Evaluation and Review**

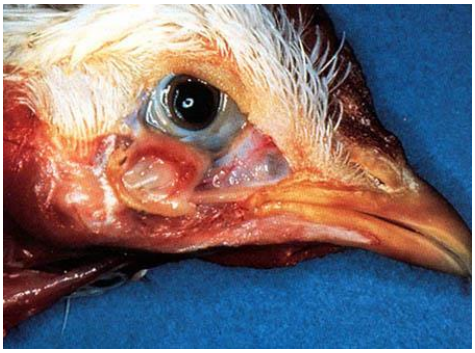
The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 5. Health Management and Egg or Meat Consumption

Topic 1. **Introduction**



Health management is an important component of poultry production. Infectious disease-causing agents spread through a flock very quickly. In Bangladesh, the most common diseases that affect free-range or semi-scavenging birds are Newcastle disease (Ranikhet), fowl pox, and fowl cholera. High chick mortality is associated with poor feeding, housing, and health control practices. Night shelter should have good ventilation, adequate light, and protection from predators. The materials used for night shelter, such as wood and bamboo, offer a good hiding place for external parasites. Therefore, it is important to clean the night shelter regularly. Free-range or semi-scavenging chicks are at risk of parasitic infestation; therefore, deworming at two- to three-month intervals is required. Under free-range or semi-scavenging conditions, adult birds should be vaccinated against the aforementioned diseases.

Topic 2. **Complementary Feeding for Children Ages 12–24 Months**

See SPRING *Community Worker Handbook,* Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 12-24 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Symptoms and Control of Various Chicken Diseases**

Diseases of Local Chicken

1. Ranikhet

This deadly, viral disease attacks chickens of all ages during various times of the year (but usually in winter and spring).

Cause: virus from paramyxo group

Symptoms:

- If severe, 100 percent of chickens will die.
- If moderate, chicks will take long, drawn breaths with mouth open and cough with a rattling sound in the throat.
- White lime-like diarrhea
- Runny nose
- Wings droop

Treatment: No effective treatment exists. However, 10-15 percent of chickens can survive if antibiotics, such as enrocin syrup mixed with water, are administered.

Dosage: 1 cc (cubic centimeter) mixed in 1 l water for 3–5 days.

2. **Coccidiosis (usually affects chicks 14–21 days old)**

Generally, 14-21 day old chicks are susceptible to this disease.

Cause: Various types of protozoa.

Symptoms:

- Chicks eat less, their wings become floppy, and they are tired. They also tuck their heads inside their wings.
- Blood is visible in droppings and the droppings stick around the cloacae.
- Feathers become ruffled and chicks become withdrawn.
- Infected chicks stay separate from the others and doze in the darkness.

Treatment: ESB3 or amprolium powder or embazine powder

Dosage:

- 2.5 g of powder mixed in 1 l water, which the chicken should be fed for 3 days
- 1 g of vitamin K powder mixed in 1 l water, which the chicken should be fed for 3 days

3. **Fowl cholera**

This disease can afflict chickens at any age. However, those 12 weeks and up are most often affected.

Cause: A bacterium called Pasteurella maltocida causes this disease.

Symptoms:

- Chickens can die if severely affected.
- If body temperature increases a lot, appetite and weight loss can occur.
- Eye lashes, face, and the comb swell.
- Frequent bowel movements, loose stools, and green, sometimes foul smelling droppings.
- The comb and ear lobes turn blue or blackish.

Treatment:

- Renamycin tablet - 1 tablet mixed in 2 l water, fed for 3 days
- Saline - 1 g of saline mixed in 1 l water, fed for 3 days

4. **Fowl pox**

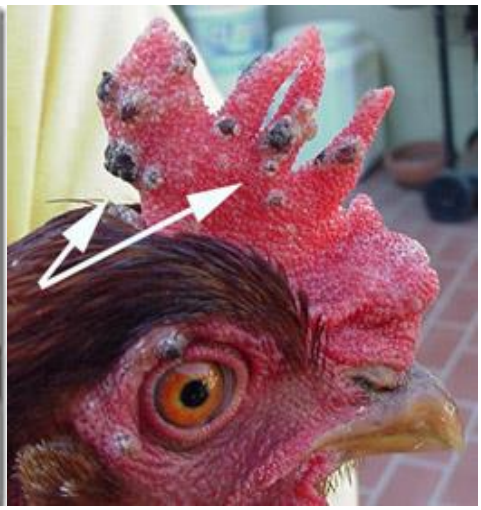
Fowl pox usually occurs in chicks at the age of three weeks, but it can occur in adult chickens of any age.

Cause: The fowl pox virus.

Symptoms:

- Small blisters appear on the eyes, combs, and earlobes.
- Body temperature increases and appetite diminishes.

- Chicks gradually wither away; they will die within a few days.

Treatment:

- Clean blisters with antiseptic.
- Renamycin powder.

Dosage: 1 g Renamycin powder mixed with small amounts of warm rice for 15–20 chicks.

5. **Worms**

Cause: Various species of worms (e.g., roundworm, tapeworms) cause this disease.

Symptoms:

- Chickens lose weight.
- Chicks have ruffled feathers and are withdrawn.
- The rate of laying eggs and feeding decreases.
- The breast bones are visible.
- The chickens appear anemic and fall down due to weakness.

Treatment: Poulnex, Avinex, Ascarex, etc. are drugs that can be found in the market(s).

Dosage: 1 g powder mixed with 250 ml water fed to 7 egg-laying hens while continuing with deworming every 2–3 months.

Topic 4. **Maintaining Biosecurity**

Biosecurity

Biosecurity is a process by which the chicken is kept free or safe from germs that cause diseases in the chicken farms. Farms with biosecurity are easier to manage and have better production.

The three main tasks of biosecurity:

1. Kill germs with antiseptics. This is usually done before placing new chicks in the farm.
2. Humans, animals, insects, rats, feed, water, air, feed wrappers, and vehicles can carry germs to the chicken sheds, but humans are usually the cause.
3. Vaccinate chickens to protect from various diseases.

Vaccination

What is a vaccine?

A vaccine is a substance made from the extract of a specific germ of a disease that can increase the body's resistance to this germ.

Why vaccinate?

Vaccines are part of a disease resistance system. Vaccines create resistance so when the disease attacks or an epidemic occurs, the chickens are protected.

Vaccination instruments:

The following instruments have to be in the kit box:

a) Syringe

b) Needles

c) Measuring cone

d) Thermo flask

e) Biforked needles

f) Dropper

g) Auto vaccine gun

h) Water bottle

i) Clean rag/cloth

In addition to the items in the kit box, distilled water and a vaccination register are needed.

Vaccines can be distributed—

- in the eyes or nose with droppers
- by dipping the beaks into the vaccine
- with potable water
- by spray or by sprinkling
- by injection.

Precaution:

a. Vaccines must be stored in the fridge at 2-6°C.

b. Vaccines need to be carried in a flask full of ice.

c. Vaccines have to be diluted in a shady place. Vaccination should be completed as soon as possible. Any remaining diluted vaccine cannot be stored in the fridge for reuse.

d. Vaccines should be diluted with diluents or distilled water per the manufacturers' instructions. Avoid using contaminated water. During vaccination, the vaccines need to be kept away from electric light and sunlight, as the heat is damaging.

e. Water-mixed vaccines should not be warm. This is why vaccine bottles need to be wrapped with ice in a clean cloth.

f. Chilled vaccines should only be used when the exterior temperature is between 15-25°C. The bottles should be shaken from time to time.

g. When applying vaccination via eye drops, the chick needs to be held for some time after application to ensure it has absorbed the drops. The chick should be gently released back to the litter.

h. After gathering all chickens in one place, vaccines should be diluted, and vaccination of each chicken should be done one by one.

i. The vaccine instruments (e.g., syringe, needles, beaker, dropper, etc.) should not be cleaned with chemicals or antiseptics. Cleaning them with boiling water is sufficient.

j. After vaccination, the empty bottles and unused vaccines should be buried in the ground or burned.

k. Vaccines should not be administered to a diseased chicken; vaccines should be given at least one week after the chicken recovers from illness.

l. One day before vaccination and one day after it, multivitamins should be provided to help the chicks recover and increase the effectiveness of the vaccines.

m. Provide poultry with a balanced diet.

n. Use standard quality drugs for disease control.

Reasons why vaccination may not be successful:

Sometimes after vaccinating, the same disease may reoccur. This happens for various reasons:

- The vaccines were not properly stored.
- The vaccine was past its expiry date.
- The manufacturer's instructions were not followed.
- The chickens were vaccinated on a very sunny, hot day.
- The vaccines were directly exposed to sunshine.
- The vaccines were used beyond the specified time after diluting.
- The vaccines did not enter the body properly.
- The vaccination instruments were not germ free and sterilized.
- The vaccinator's hands were not clean or germ free.
- The vaccines were not administered at correct intervals.
- Low-quality drugs were used for disease control.
- Sick chickens were vaccinated.
- Disease-resistance capacity of chicks was insufficient.

Poultry vaccination schedule

Sl no	Name of the disease	Name of the vaccine	Quantity of distilled water to be diluted (CC)	Age of chicken to be vaccinated	Spot of vaccination	Quantity of vaccines (CC)	Next dose	Comments
1	**Ranikhet** (First **dose)**	BCRDV	6	First time at the age of 3 to 7 days	In any of the eyes	One drop with a dropper	After 21 days	
2	**Ranikhet (Second dose)**	BCRDV	6	Second time at the age of 20 to 21 days	Same	Same	No more required	
3	**Fowl pox**	Pigeon pox	6	At the age of 10 to 14 days	In the feather free spot under the wings	With a special needle, poke puncture on the skin in two places	After 21 days with the same method	no more need for the rest of the chicken's life, if chicken can be vaccinated properly twice
		Or fowl fox	6	At the age of 28 days to 1.5 months	Same	Same		Same
4	**Ranikhet**	RDV	100	First time at the age of 2 to 2.5 months	in the flesh of leg	1	4 to 5 months interval	throughout the life
5	**Fowl cholera**	Fowl cholera	no need to dilute	At the age of 2.5 to 3 months	under the skin	1	6 months interval	

Prevention is better than curing.

Topic 5. **Nutritional Value of Chicken, Eggs, and Meat**

Protein Value of Eggs and Meat

Two types of eggs are available in Bangladesh: farmed and local. Many people prefer local eggs and believe that farm eggs provide inadequate nutrition, but this is not true. Farm eggs are actually more nutritious since they are larger than local eggs and contain 80 calories each, whereas local hen eggs contain only 50 calories.

Eggs are an ideal food because they contain digestible protein. An egg yolk contains 250 mg of cholesterol, which is saturated fat. The nutrition value is the same regardless of how the eggs are prepared (boiled, poached, or in an omelet).

Benefits of Eggs and Meat for Children and Pregnant and Lactating Women

- Chicken eggs are the cheapest source of animal protein.

- Eggs are ideal for those experiencing ill health and for pregnant mothers.
- Eggs are essential for child growth.
- Eggs are good for rheumatoid fever patients.
- It is a misconception that eggs have a negative effect on jaundice or diarrheal patients.
- Those with heart disease should avoid egg yolks.

Chicken is a popular food in Bangladesh and is prepared in many different ways.

Chicken is an important source of animal protein. It is possible to fulfill the recommended daily protein intake by eating 113 g of chicken.

Benefits of Chicken Meat

- It contains calcium, which helps to reduce bone caries and promotes growth.
- It contains important vitamins (e.g., B12) that can help prevent diseases, such as cancer.
- Chicken meat is easy to digest (metabolic activity is easier).
- Protein from chicken meat is essential for normal fetal growth.
- Eating chicken meat can increase the size and weight of a fetus.
- Eating chicken liver can help to reduce blood deficiencies in women (i.e., anemia).

Topic 6. **FMA on Poultry Coops: Improved Versus Traditional**

_____ farmer nutrition school

Farm management analysis-4 (hen rearing)

Group Name: Date:

Farmer Name:	Number of large chickens:
Number of medium-sized chickens:	Number of chicks:
Drawing Picture: Chicken coops, roof of coops, shed of coops, condition of floor and picture of its environment, etc.	

Observation sheet (questionnaire) for visiting farms:

Subject of Observation	Present situation/observation	Decision
Hygienic condition of coop		
Hygienic condition of environment		
Entrance of air and light		
Coop free from germs		
Vaccination		
Hygiene of feeder and drinker		
Feeding		
Space for sick hen		
Weight of chicks and hen		
Laying eggs again after separation		

Topic 7. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 8. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 6. Essential Nutrition Actions and Essential Hygiene Actions

Topic 1. **Introduction**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 2. **Key Messages and Practices of Essential Nutrition Actions/ Essential Hygiene Actions**

See the SPRING *Community Worker Handbook*, Section 1. Key Essential Nutrition Actions (p7-19) and Section 2. Key Essential Hygiene Actions (p21-25).

Topic 3. **Group Work**

The technical content referenced above should be used to conduct this topic.

Topic 4. **Session Evaluation and Review**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 5. **Conclusion and Planning for Next Session**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Module 3: Pond Fish Culture

Session 1. Understanding Pond and Improved Fish Culture Techniques

Topic 1. **Introduction**

In rural Bangladesh, many households are endowed with small ditches, canals, and small ponds. These homestead ponds are generally excavated when soil is required for raising the homestead plinth to protect the homes from floods. In most cases, these ponds lie unused or underused. Instead, they can be used for fish culture so that pregnant women, lactating mothers, and children under 2 can benefit from essential animal-source foods.

The aim of this session is to encourage women to culture fish and to teach them about the dietary importance of fish, especially small indigenous fish. This session will help women learn about different types of ponds for fish culture, different types of fish culture systems, and the "ideal" pond. Upon completion of this session, they will be able to prepare a production plan for fish culture in their own ponds, and thereby ensure year-round supply of nutrient-rich fish for their families.

Topic 2. **Introduction to Diet for Pregnant Women**

See SPRING *Community Worker Handbook*, Practices: 1. Diet for Pregnant Women (p.8); 2. Iron Supplementation during Pregnancy (p.9); 9. Importance of Vitamin A (p.17); 10. Preventing Anemia (p.18); and 11. Using Iodized Salt (p.19).

Topic 3. **Importance of Fish Culture and Different Types of Ponds**

Importance of Fish Culture

- Fish are an important source of easily digestible animal-source food.
- Fish contain a lot of calcium, phosphorus, iron, and iodine, which are helpful for physical and mental growth and prevent decay and diseases.
- Small fish are a great source of vitamin A, which is important for eyesight and prevents night blindness.
- Fish contain Omega-3 fatty acids, which prevent heart attacks and reduce inflammation of the lungs.
- Fish contain a lot of vitamin B-12, which produces blood cells.
- Small fish are a source of vitamin D, which helps the body absorb the calcium needed to form bones.
- Fish is expensive in the market, so many families cannot afford to buy it (although they like it), which can result in undernutrition. Fish culture is a way to ensure better family nutrition.
- Unused or underused ponds are a habitat for mosquitoes, fleas, insects, and other harmful living organisms. Disease can spread quickly if this type of pond is located near a house. Fish culture in ponds reduces breeding of harmful insects and mosquitoes.

Types of Ponds

Seasonal pond: A seasonal pond is one where water is available at the optimum depth for four to five months; however, in the dry season, the water depth is lower and it might even dry up, making it unsuitable for fish culture. Fish that grow quickly and can be harvested within a very short period of time are suitable for culture in this type of pond. They include tilapia, Thai punti, grass carp, and *mola* fish.

Year-round (perennial) pond: A perennial pond is one where water is available at the optimum depth throughout the year. All types of fish can be farmed in such ponds. They include rohu, silver carp, catla, mrigal, mirror carp, and common carp.

Topic 4. **Fish Culture Systems and Ideal Pond Environments**

Fish Culture Systems

In Pond: Mono and composite cultures can easily be done in small, medium, or large ponds. If a pond holds water for less than three months, it is generally not suitable for fish culture, at least not profitably.

In Gher: In shallow paddy land, where water is available for at least three to four months, prawn and carp or tilapia can easily be cultured together with or alternative to the paddies by blocking the open ends using dikes/fencing.

Pen culture: Blocking one or both sides of the water body (generally the canal) with bamboo fencing.

Cage culture: Those who have no pond can prepare a cage and set it in the river, canal, or even in other people's ponds and then culture fish.

Jalmohal: When a river or canal becomes very old, is closed, and has no current, it is called Jalmohal. Jalmohal can be effectively used for fish culture by closing the open end(s) with fencing (using bamboo-made "bana" or strong fishing nets).

Flood plain: Fish can be cultured together in groups at flood plains.

An ideal pond environment for fish culture includes the following:

- The dike is high enough and compacted, so it is protected from flood and tidal water.
- It has a plain rectangular bottom.
- The soil texture is clayey, loamy, or sandy loamy.
- The depth of the mud at the pond's bottom should not be more than 6-8 inches.
- The dike is free from big trees and bushes.
- It receives adequate sunlight (5–7 hours a day).
- The depth of water is 5–7 feet.
- The water pH is 7–8.5.

Topic 5. **Production Planning for Pond Fish Culture**

When making a fish culture plan, the following issues should be kept in mind: financial investment, labor, availability of water, fingerlings, fertilizer, feed, and other production inputs. One area's fish production plan may differ from another area's plan.

Sample production plan for fish culture:

Activities	J	F	M	A	M	J	J	A	S	O	N	D
Digging/renovation of pond												
Weeding, clean twigs around tree												
Removal of predatory fish												
Liming												
Fertilization												
Fish stocking												
Feeding and post stocking fertilization												
Partial harvesting and restocking												
Complete harvesting												

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 2. Preparing the Pond for Fish Stocking

Topic 1. **Introduction**

Successful fish culture mostly depends on successful pond preparation. Even if all other activities are done well (e.g., stocking good fingerlings and applying quality fish feed) fish production will be lackluster if the pond is not prepared properly. In this session, the farmers will learn about the importance of pond preparation for fish culture, including the different steps of pond preparation and how to perform them.

Topic 2. **Breastfeeding Children from Birth to Six Months and Diet for Lactating Mothers**

See SPRING *Community Worker Handbook*, Practices: 3. Early Initiation of Breastfeeding (p10); 4. Exclusive Breastfeeding to Six Months of Age (p11-12); 5. Diet for the Lactating Mother (p13); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Importance of Pond Preparation: Water Extraction, Cleaning Aquatic Weeds, and Repairing Dikes and Beds**

In each production cycle, ponds should be prepared properly before stocking the fingerlings. Like all other animals, fish need a suitable environment to live and grow properly. Pond preparation should begin in the dry season immediately before the monsoon (since most of the ponds are rain fed) and, of course, before stocking fish fingerlings. Well-prepared ponds ensure a higher production of fish.

Steps: The following steps should be performed in pond preparation:

- Repair pond dikes and level the bottom.
- Clean bushes and cut tree branches around the pond.
- Clean aquatic weeds.
- Eliminate predatory fish.
- Apply lime.
- Apply fertilizer.
- Check the pond's natural food production.

Repairing of the Pond's Dike and Leveling the Pond Bottom

Dikes should be well built and high enough so that predatory fish or polluted water cannot enter the pond during the rainy season or during a flood. Well-developed dikes enable the pond to retain water at a higher depth and for a longer period. Dikes are generally repaired or built using mud taken from the pond bottom, which is generally very fertile due to sedimentation of fish feed and/or manure supplied in the pond. Pond dikes are, therefore, very suitable for vegetable and/or fruit production. The dry season is the best time to repair the pond's dikes and level its bottom.

Leveling the bottom of the pond is especially important for netting (fish harvesting and monitoring of the growth and health of the fish). Fish can easily hide on the bottom of the pond if any holes or ditches are present. Excess mud results in the accumulation of harmful gases on the pond floor and thus reduces the

oxygen levels of the water. This can lead to a deterioration of the water quality. Generally, 4–6 inches of mud can be kept on the bottom. Repairing pond dikes and pond bottoms can be done by drying up the pond once every two to three years.

Clearing Bushes and Tree Branches around the Pond

Sunlight is essential for the production of natural food in the pond (photosynthesis), so cutting off all hanging branches and twigs over the pond is necessary. Predators, like snakes and frogs, may hide inside bushes, so any bushes on the side of the pond should be removed.

Clearing Aquatic Weeds

Common types of aquatic weeds include water hyacinth, kolmilota, helencha, and water lilies. These weeds block sunlight from entering the water and suck out the water's nutrients. As a result, natural fish food production declines. Moreover, predatory animals, such as snakes and frogs, can easily hide in the aquatic weeds and spread diseases.

Measuring the Pond Area

$$\text{Pond area (Decimal)} = \frac{\text{Length (Feet) X Width (Feet)}}{435.6}$$

Topic 4. **Elimination of Predatory and Unwanted Fish**

Fish that eat other fish are called predatory fish; e.g., snakehead murrel (shoul), spotted snakehead (taki), great snakehead (gozar), wallago (boal), koral, scribbled goby (bele), and bronze featherback (foli). Predatory fish hunt stock fish in the pond, causing the gradual reduction in the number of fish.

Different Ways of Eliminating Predatory Fish

1. **Dry out the pond:** Dewatering is the best method of eliminating predatory fish. Drying out the pond water also eliminates excess mud at the bottom of the pond, increases soil fertility, removes polluted gas, and strengthens soil texture. However, this process is expensive and sometimes it can destroy the pond dikes.
2. **Repeated netting:** Repeated netting can eliminate predatory fish from the pond, but it is not possible to eliminate all of them with this method.
3. **Using fishing hooks:** Predatory fish can be eliminated by catching fish using fishing hooks, but it is not possible to eradicate all predatory fish from the pond this way.

4. **Application of rotenone:** Predatory and undesirable fish can be eliminated through the application of rotenone. Rotenone reduces the cellular uptake of blood oxygen, so fish cannot breathe and float to the surface of the water. Rotenone remains effective in the pond for the first 24 hours of application and remains for 7 days in an inert state. Twenty-five to thirty grams of rotenone (9 percent) is necessary for each foot of the pond's depth and per decimal of water area. The functional ability of rotenone depends on temperature and it is important that rotenone be used on sunny days.

First, divide the total amount of rotenone in three parts. Take one-third of the rotenone, make the dough, and then divide the dough into several small balls. Finally, throw those balls uniformly in different parts of the pond. The rest of the rotenone should be mixed with water and spread across the pond. Within 25–30 minutes of rotenone application, fish will begin to float to the pond's surface. These floating fish can be easily caught using a net. Fish killed by rotenone are safe to eat; however, other types of poison should not be used to catch predatory fish because they are toxic to humans.

5. **Water supply in the pond/increase of depth of water in the pond:** Firstly, the bed of the pond should be dried out; then water should be pumped back into the pond. A 5–7 foot deep pond is sufficient for fish culture. It is important that undesirable and harmful fish and animal eggs do not pass through when water that is being re-pumped into the pond. For this reason, nets with a very tight mesh should be placed at the entrance of the water. Primary stocking of fingerlings is possible when the water height is at least 3–4 feet. Fingerlings may die when the water becomes hot. This is why a depth of 5–7 feet is good for fish culture.

Topic 5. **Application of Lime**

Lime application is needed during pond preparation and throughout the production cycle, especially before the winter season when the chances of disease infestation are high.

Lime application is important because—

- it kills most harmful microorganisms, especially parasites
- it provides the calcium that is needed for fish growth
- it makes the fish's scales and bones strong
- it removes turbidity from the water
- it removes toxic gas from the water
- it cleans the water and thus increases light penetration
- it creates an environment for production of natural fish food
- it neutralizes the acidity and alkalinity of water and works as a buffer.

The required amount of lime depends on the soil quality of the pond. A pond with moderate acidity needs on average of 1 kg limestone per decimal of water.

Methods of application and caution:

The activation of lime depends on temperature. Lime application is usually good to do on a sunny day, generally from 10:00 a.m. to 11:00 a.m. On cloudy or rainy days, lime application does not yield good results. Many varieties of lime are available in the market, but limestone is the best for fish farming. Lime in its powder form should not be used since it will not serve the purpose.

Lime should be dissolved in an earthen pot, cemented jar, iron-made drum, or a pit in the ground. A plastic bucket is not suitable as lime is corrosive. To dissolve the lime, you need sufficient water. Lime should be added to the water and not the other way around. This diluted solution should be spread in the direction of (not against) the wind, so lime will not come in contact with the face or body of the person who is applying it. If used in a pond stocked with fish, lime should be dissolved in water and then kept in the solution for 12–14 hours to lower the temperature. Lime better to be applied in the morning at around 8:00 a.m.–10:00 a.m.

Topic 6. **Application of Fertilizer**

Fertilizer

Fertilizer is an organic or inorganic substance that increases the fertility of the land or pond water by providing essential nutrients for plants.

Importance

Use of organic or inorganic fertilizer increases the production of phytoplankton, zooplankton, small insects, and worms, which are the main natural foods for fish. Applying organic and/or inorganic fertilizer to a pond is essential because fish production will increase when production of natural food increases. The optimum level of fish production can be obtained using only organic fertilizer. A combination of both types of fertilizer is also widely used, especially in composite fish culture systems.

Fertilizer, which is produced from the decomposition of biological debris such as green grass, leaves, water hyacinth, cow dung etc., is called organic fertilizer (or compost). Organic fertilizer can be prepared with household items and requires only a very small amount of money for preparation. Fertilizer that is prepared commercially is called inorganic fertilizer (e.g., urea, TSP, and MoP).

Amount of Application

During pond preparation, the following amounts of organic and inorganic fertilizer are used:

Cow dung:	5-8 kg/decimal
Urea:	150-200g/decimal
TSP:	75-100g/decimal

Application Method

Generally, fertilizer is used five to seven days after lime application. TSP does not dissolve quickly in the water, so it has to be soaked overnight with a sufficient amount of water. In the morning, dissolve the urea in water, then add the cow dung and finally the diluted TSP. All fertilizer (the mixture of urea, TSP, and cow dung) should be spread in the pond in the morning, preferably at 10.00 a.m. Sunlight is necessary for fertilizer to be effective; therefore, fertilizer should not be applied on a cloudy or rainy day.

Topic 7. **Examination of Natural Food in Ponds**

Observe the color of the water: Phytoplankton and zooplankton are natural foods for fish. Plankton will appear within 7–14 days of adding fertilizer to the pond water. Plankton usually cannot be seen with the naked eye. If the water turns light green, a greenish brown, or brownish, this indicates that the water is rich in plankton and is ready for fish stocking.

Examine by hand: Put your hand in the pond until the water reaches your elbow. If you can see your palm easily, not enough plankton is being produced. If your palm cannot be seen properly, then the water is rich in plankton.

Examine through transparent glass: Drag a thin cotton cloth (*gamcha, one kind of towel used traditionally in Bangladesh*) in the pond water 5-7 days after fertilization to collect some watery sediments. Put the sediments in a transparent glass. Hold the glass up to the sun to see if very small insects are moving around. If you can see the insects with the naked eye, the water has adequate natural food.

It is best to stock the pond with fingerlings after producing natural food/plankton.

Topic 8. **Practicum: Using Rotenone, Lime, and Fertilizer**

First, divide the participants into four to five small groups. Next, select a topic for each group and provide the necessary materials for practical work. Give the groups directions and assist them with their practical work.

- Pond area measurement
- Application of rotenone
- Application of lime
- Application of fertilizer
- Methods of examination of natural foods in pond

Topic 9. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 10. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 3. Fingerling Transportation and Stocking

Topic 1. **Introduction**

Composite fish culture generally gives the best result in pond farming since different species take food from different niches. Farming a variety of fish species is also good for nutrition. Fish should be stocked in the correct proportion and density for optimum yield. Only strong, healthy, and pure fingerlings should be stocked for the best yield.

Fingerling transportation must be managed carefully. Fingerlings can die en route to their destination if they are not properly transported and transferred to the pond. The water used to transport the fish seed should contain sufficient oxygen; otherwise the fish will die from suffocation.

This session will demonstrate the correct selection of species, stocking density, transportation, adaptation, and the stocking process.

Topic 2. **Introduction to Key Essential Hygiene Actions**

See SPRING *Community Worker Handbook*, Practices: 12. Handwashing (p22); 13. Making a Tippy Tap for Handwashing (p23); 14. Keeping the Environment Clean of Feces (p24); and 15. Keeping Containers and Food Clean (p25).

Topic 3. **Species Selection for Stocking the Pond**

Ponds contain three layers: an upper layer, a middle layer, and a bottom layer. Each layer contains different types of natural foods that attract different fish species. If the pond is stocked with the right combination of species, each layer will be kept in balance and the pond will produce a strong yield. For example, if a pond is stocked only with silver carp, only the upper layer feed will be used, and the middle and bottom layers' feed will be unused. Therefore, it is important to stock fish that will maintain the ratio of all layers.

Fish of the upper layer:

What types of fish?

- Catla
- Silver carp
- Big head carp

What do they eat? They eat phytoplankton and zooplankton in the upper layer of the pond.

Fish of the middle layer:

What type of fish?

- Rohu

What does it eat? It eats zooplankton, small insects, and periphyton.

Fish of the lower layer:

What types of fish?

- Mrigal
- Mirror carp
- Shrimp
- Kaliboush
- Black carp
- Pangus

What do they eat?

- Micro insects in the bottom/Benthos
- Algae
- Snails and oysters
- Organic substances
- Zooplankton

Fish in all layers:

- Olive barb (Sorputi)
- Grass carp

What do they eat?

- Aqueous plant and soft grass
- Weeds and leaves
- Kalmi and Helencha shak
- Banana leaves, *Ipil-Ipil* leaves
- Vegetable waste

Even though all types of fish can live in the same pond, certain species eat specific types of natural food at different levels. For example, enormous amounts of phytoplankton exist in the upper layer of a pond, and therefore fish like silver carp and catla prefer to live in this layer. Similarly, rohu is generally available in the middle layer of the pond, where zooplankton grows. Fish such as the mirror carp, common carp, calbaush, and shrimp live by eating insects at the bottom of a pond or in the mud. A few fish, such as the Thai punti and grass carp, can move across different levels of the water column. They are herbivorous and eat green grass and leaves.

Species selection criteria:

- Good nutritional value
- High growth rate
- Disease resistance
- Tasty
- Species that are in higher demand and, therefore, command a better price in the market
- Availability of fingerlings in the locality
- No competition with other species over natural foods
- Not predatory in nature
- Not harmful for the environment

Topic 4. **Stocking Density According to Layer**

Stocking density: Stocking density is the number of fingerlings needed to populate a pond. High stocking density of fingerlings causes deficiency of food, oxygen, and space and can result in poor fish growth, decreased production, and increased risk of disease outbreak. On the other hand, if stocking density is too low, the available food and space are underutilized. Total fish production will be lower, but the growth rate of fish will be higher. It is important that stocking density is at the optimum level for the carrying capacity of the waterbody; it should be neither too high nor too low. However, stocking density also depends on fish culture methods.

Suggested stocking density of fingerlings from SPRING: 50 pieces per decimal area

Upper layer: 20 fingerlings (Catla-8, Silver carp-12)

Middle layer: 10 fingerlings (Rohu-10)

Bottom layer: 10 fingerlings (Mrigal/Kalibasu/Mirror carp/prawn)

In all layers: 10 fingerlings (Grass carp-2, Olive barb (Sorpunti)/Tilapia-8).

Total: 50 fingerlings/decimal

When catla and silver carp fingerlings are stocked together in a pond, the catla should be bigger in size. Otherwise, the catla will not be able to compete with silver carp for food, and growth will be slower, resulting in less production.

If the water depth is low, the middle layer may become very narrow/short, In such instances, rohu should be stocked in smaller numbers. The amount of grass carp may vary depending on the availability of grass or green leaves to be provided every day. Stocking density may change in different places, depending on various factors, such as fertility of the pond and water temperature.

Size of fingerlings: Fingerlings should be at least **3-5 inches** long.

Stocking density of *mola* fish: *Mola* fish can be cultured in both monoculture and mixed culture systems.

Mixed culture: Together with carp fish, 80–100 pieces of *mola* fish/decimal waterbody (the weight of *mola* fish should be 150–200 g).

Monoculture: 400 pieces of *mola* fish/decimal waterbody.

Special management for *mola* fish: *Mola* fish usually eat the natural food that grows in the upper layer of the water. Matured *mola* breed two to three weeks after stocking. At the start of the month of Baishakh (mid-April), they release eggs on floating and sinking leaves or in the grass of the shallow water. After 20–25 days of breeding, the fry (baby/very young fish) swim in a shoal. No netting should be done at that time and ducks should be kept out of the pond. Brood *mola* fish should be stocked before the breeding season (mid-April to May).

Topic 5. **Selecting Quality Fingerlings for Stocking**

Identification of Fingerlings

- Catla: The lower lip is larger than the upper lip; it has a fleshy, wide mouth and head.
- Silver carp: The lower lip is larger than the upper lip; it has a fleshy, sharp mouth, flat head, and glittering body, similar to the Ganges River gizzard shad (chapila) fish.
- Rohu: The lower lip is slightly smaller than the upper lip; the head is located on the lower side; it is wrinkled and fleshy, and it has a medium to large head.
- Mrigal: The lower lip is smaller than the upper lip; the head is small.

Characteristics of Healthy Fingerlings

- No unusual spots are on the body of healthy fingerlings.
- The shape of healthy fingerlings is normal; proportion of body and head is normal.
- Eyes of healthy fingerlings appear bright and transparent.
- Slime is present on the body (but not an excessive amount) and body is oily.
- Gills appear bright red.
- Healthy fingerlings can hear. If you gently beat the bowl, fingerlings will move fast.

Source of Quality Fingerlings

In addition to proper management in the nursery, the quality of fingerlings depends mostly on the quality of the brood (parent) fish. Healthy fingerlings can be obtained from nurseries that use fish spawn from hatcheries that have quality brood fish. Therefore, fish fingerlings should be purchased from a reliable nursery or retailers (*patilwalas*) who sell the fish from those nurseries.

Topic 6. **Transportation, Adaptation, and Stocking**

A farmer should assess fingerlings' quality, size, and shape before purchasing.

Food should not be added to the pond for at least 12 hours before stocking the fingerlings. This measure will help reduce mortality. Morning (7:00 a.m.-8:00 a.m.) is the best time to carry fingerlings because the temperature is generally low. Fingerling deaths will be minimized if the fingerlings are kept in a *hapa*[2] before stocking and are hardened[3] for up to 2–3 hours.

During transportation, avoid placing too many fingerlings in one pot, as they could die due to oxygen deficiency. An aluminum pot or tin drum can be used to carry fingerlings, but it needs to be covered with a wet cloth or gunny bag to keep the container cool. An oxygen-full polyethylene bag can also be used. Generally, a 24-liter, water-filled pot can accommodate 150–200 fingerlings. During transportation, agitate or splash the water with your hands to prevent oxygen deficiency (the motion helps dissolve oxygen from the air). If the water becomes dirty (e.g., due to defecation of the fish), some of the water can be replaced with clean water. Care should be taken so the fingerlings are not injured during handling.

The fingerlings need to slowly adapt to the pond water because of the differences between the temperature in the pond and the water in the pot. The mortality rate of fingerlings will increase if fingerlings are released directly into the pond immediately after transportation. For this reason, after reaching the pond, pots should be suspended for 20–25 minutes in the pond. After that, some water from the pot should be taken out and an equal amount of water from the pond should be added to the pot. This process should be done for a few minutes until the temperatures of the pot water and the pond water are the same. When both temperatures are equal, tilt the pot slightly and create a small wave so the fingerlings can swim into the pond voluntarily. Do not force the fingerlings into the pond. As mentioned above, it would be better to arrange a *hapa* when releasing the fingerlings.

Best Time for Fingerlings Stocking

Fingerlings stocking should be done when the weather is cold. It is better to release fingerlings either in the early morning or in the late afternoon.

[2] This is like a mosquito net which is generally made of very fine mesh fishing net. It is placed in the pond with the open side on top, above the water. It acts like a small pond within the pond.

[3] Adjusted with the new water/stocking pond, which is also larger and deeper than the nursery pond, to avoid shock.

Mola Fish Transportation

- To prepare the fish for live transportation, careful netting should be done at least twice (1-2 days interval) and 3-4 days before catching them.
- Use a soft type of net while collecting the fish, otherwise they will die or become injured.
- When collecting fish, big carp can be separated from *mola* fish very quickly.
- 400-500 g brood *mola* fish can be transported in 10 l water.
- Transporting brood *mola* fish is easier than transporting carp because they are small.

Topic 7. **Practicum: Selection and Stocking Fingerlings**

Firstly, divide the participants into four or five small groups. Next, select a topic for each group and provide the necessary materials for practical work. Give the groups directions and assist them with their practical work.

- Identification of fingerlings by species
- Identification of healthy fingerlings
- Adaptation of fingerlings
- Releasing fingerlings

Topic 8. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 9. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 4. Supplementary Feeding, Pond Fertilization, and Liming

Topic 1. **Introduction**

Strong growth and health are important for achieving optimal fish production. Fish growth and health depends on many factors: maintaining the water quality, ensuring natural food availability in the pond throughout the production cycle, and providing supplementary feed regularly. This session will teach farmers how to perform these activities.

Topic 2. **Complementary Feeding for Children Ages 6–11 Months**

See SPRING *Community Worker Handbook*, Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 6-8, & 9-11 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Application of Supplementary Feed**

Like any living being, fish need food to survive and grow properly. Fish foods are classified into two categories: natural foods and supplementary feed. Natural foods are those that are produced in the pond, such as phytoplankton, zooplankton, insects, etc. Supplementary feed is supplied directly to the pond from an outside source, such as rice bran, wheat bran, soybean, maize, etc.

Supplementary feed is divided into two groups: plant source and animal source.

- Plant source: Rice bran, wheat bran, oilcake, soybean, etc.
- Animal source: Fish meal, crab and snail meat, etc.

Natural foods are generally rich in protein but not in carbohydrates. Therefore, it is better to provide these carbohydrate-rich foods through supplementation (hence they are called supplementary feed). Supplementary feed helps reach the increased production targets driven by rapid population growth and limited resources. The importance of supplementary feed:

- Fish can be stocked in high density.
- Fish grows faster and more production comes from small ponds.
- It increases immunity.
- It reduces mortality rate.

Considerations for Supplementary Feed Preparation

Farmers usually use oilcake, rice bran, wheat bran, and soybean as supplementary feed. These feeds have different nutritional values. One of the main objectives of fish farming is to produce more fish and earn more profit. Therefore, the nutritional value and quality of the food should be considered when deciding which supplementary foods to prepare. The following four factors should be considered when choosing supplementary food:

- Local availability of production inputs
- Nutritional value
- Cost-effectiveness
- Food liked by fish

Preparation of Supplementary Food

Protein plays an important role in the physical growth of fish. Dry fish powder, crab, snail, oyster meat, etc. are high in protein and should be considered during feed preparation. Different elements can be used during preparation of supplementary feed. The composition of supplementary feed is given below.

Rice bran-25 percent; wheat bran-25 percent; oilcake-25 percent; fish meal-25 percent; and some molasses to help bind the mixture.

Oilcake should be dissolved in water at a 1:2 ratio (i.e., one part oilcake for two parts water) 12–24 hours before application. Next, the rest of the elements can be added slowly to the mixer to prepare the dough. Once the dough is prepared, create small balls from the mixture for supplementary feed application.

Quantity and methods of supplementary feed application:

The amount of supplementary feed needed depends on the natural food production and the method of farming. Feed should be supplied daily at 3 percent to 5 percent of total body weight.

Feed application for *mola* fish:

No additional feed is needed for *mola* fish for the mixed culture system. For the monoculture system of *mola* fish, only rice bran and oilcake should be given at a 50:50 ratio at the rate of 5 percent to 7 percent of the fish's body weight.

Method of application:

All feed items should be divided equally into two groups and applied twice daily in the morning and afternoon.

Consider these issues before applying supplementary feed to a pond:

- Food demand is high during the summer and low during winter.
- Less food should be given on rainy or cloudy days.
- For better consumption, supplementary feed should be provided every day at the same time and place. The amount of food should be appropriate to the type and weight of the fish.
- The amount of supplementary feed required should be estimated after 15 days to 1 month and on the basis of body weight.
- Less feed will be wasted if a feeding tray is used.
- Feed supplementation should be stopped if fish float to the surface of the water, if they are infected by disease, or if they do not eat the feed.

Topic 4. **Post Stocking Fertilizer and Lime Management**

Fertilizer increases the efficiency of natural food production in the pond. Application of fertilizer depends on the pond's soil and stocking density. Organic and inorganic fertilizers can be used in the pond. For natural fish food production, the following types and amounts of fertilizers have to be applied as follows per decimal area of the pond every seven days.

- Cow dung/compost: 2-3 kg
- Urea: 50 g
- TSP: 50 g

It is best to apply fertilizer every day; however, if that is not possible, it can be applied every seven days.

Rules for Fertilizer Application

Dissolve one part TSP fertilizer in two parts water the day before application. Add it to a solution of urea and cow dung. Apply the mixture on a sunny day (preferably in the morning, around 10:00 a.m.) uniformly throughout the pond.

Caution in Fertilizer Application

- Stop applying fertilizer if water becomes too green.
- Fertilizer should be applied on a sunny day.
- Fertilizer should be applied five to seven days after application of lime.
- Do not apply fertilizer when fish are breathing on the surface of water (gulfing).
- Calculate the quantity of fertilizer carefully before applying.
- Reduce the amount of fertilizer during winter or even stop applying fertilizer if the weather becomes too cold.

Post-Stock Lime Management

Lime application is essential (even after fish stocking) for the reasons described above.

Quantity of Lime to Be Applied

The quantity of lime needed depends on the quality of the soil. For carp fish, apply 300 g of lime every month or every two months per decimal area of water, depending on the quality of the pond water. Before the start of winter, 500 g of lime per decimal area should be applied, especially to prevent the spread of disease.

Caution in Lime Application

- Apply lime five to seven days before fertilizer application.
- Apply on a sunny day.
- Proceed with caution when dissolving the lime in water.
- Lime should be spread in the same direction as the wind.
- Avoid lime application on a rainy or cloudy day.
- Cover the face with cloth or a towel during lime application.

In general, 300 g of lime per decimal area should be applied every three months, but the quantity should be modulated depending on the water quality and amount of fish in the pond.

Topic 5. **Practicum: Application of Supplementary Feed**

- Supplementary feed preparation
- Application of supplementary feed

Firstly, divide participants into four or five small groups. Next, select a topic for each group and provide the necessary materials for practical work. Give the groups directions and assist them with their practical work.

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 5. Health and Growth Management and Fish Harvesting

Topic 1. **Introduction**

When fish culture management is poor, fish can easily become infected with diseases. Infected fish are difficult to cure since the whole pond needs to be treated, which can be expensive. Therefore, prevention is better than curing.

In this session, farmers will learn about common fish diseases (symptoms and treatment), common management problems in fish culture, and their remedies. In addition, farmers will learn the importance of partial harvesting and will be encouraged to partially harvest the larger fish and periodically restock juvenile fish so that a pond's total production can be significantly increased.

Topic 2. **Complementary Feeding for Children Ages 12–24 Months**

See SPRING *Community Worker Handbook*, Practices: 6. Introducing Complementary Foods through Diversified Diet (p14); 7. Frequency and Quantity of Feeding for 12-24 Month-Old Child (p15); 8. Feeding a Sick Child During and After Illness (p16); 9. Importance of Vitamin A (p17); 10. Preventing Anemia (p18); and 11. Using Iodized Salt (p19).

Topic 3. **Common Diseases of Fish**

1. **Epidemic Ulcerative Syndrome**

   Symptoms:

   - Small red spots, primarily on the body of the fish.
   - The muscle beneath the red spots becomes rotten.
   - Fish do not eat any feed and most of them gradually die.

   Treatment:

   - 1 kg lime per decimal pond water.
   - 1–2 g Oxitetra cycline mixed with 1 kg feed for 5–7 days.

2. **Tail and fin rot diseases:**

   Symptoms:

   - The membrane of the tail and fin is split and decayed.
   - The skin becomes less slimy and the color becomes lighter.
   - The fish die in large numbers.

   Treatment:

   - Apply 1 kg lime per decimal of pond water and 1kg salt per decimal of pond water to the infected pond.
   - 1–2 g Oxitetra cycline mixed with 1 kg feed for 5–7 days.

3. **Diseases due to malnutrition:**

   Symptoms:

   - Fingerlings/fish do not grow

- Dorsal and caudal fins are decaying
- Head becomes bigger than body
- Body of fish becomes bendy.

Treatment:

- Supply balanced (quality) supplementary feed
- Ensure mineral and vitamin concentrated feed

Topic 4. **Common Problems in Fish Culture**

Common Problems in Fish Ponds and Solutions

Deep green water in pond:

If the pond water looks greenish, stop feeding and fertilizing. Lime should be applied at the rate of 250–300 g/decimal of area.

Turbid water in pond:

Generally, muddy water creates turbidity in the pond. To solve this problem, lime can be applied at the rate of 300–350 g/decimal of area, or alum (*fitkiri*) can be applied at the rate of 250 g/decimal/foot of area.

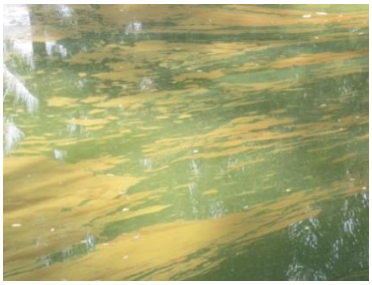
Fish floating from previous night and early morning:

High fish stocking density and oxygen deficiency cause this problem. To fix it, you have to decrease the stocking density. Stop applying fertilizer for a few days. Harmful gases should be removed from the bottom of the pond with a *horra*.[4] Create oxygen by swimming or creating waves in the water using bamboo and spraying water in the pond.

Green film on the water:

Excess algae can turn the upper layer of the water green; if this happens, stop feeding and fertilizing. Make a rope with straw and drag it over the upper layer of water to remove excess algae.

Red film on the water:



Red algae or an excess of iron in the water produces a red layer. Make a rope with straw and drag it over the upper layer of water to remove the excess red algae. To control the red algae layer, 100–150 g of urea/decimal should to be applied 2–3 times/days at 10- to 12-day intervals or apply 100 g of alum/decimal.

Some Activities/Management for Fish Culture:

Disease prevention is a far better approach to fish management than treatment. If disease breaks out, in most cases the entire pond will need to be treated, even if only a few fish are infected. Therefore, it is important to take extra care to prevent disease throughout the production cycle. The following guidelines help prevent disease:

[4] Horra is a simple local contraption made of several earthen wheels tied and hung from a long thick/strong rope. When the rope is hauled through the pond, the earthen wheels release the poisonous gases from the mud/pond floor.

- Ensure adequate light and air for the pond.
- Stock healthy and disease-free fingerlings.
- Stock at the right density.
- Follow proper care recommendations when transporting fingerlings.
- After using a net and other materials in an infected pond, fully dry them in the sun before reuse.
- Prevent infected or polluted water from outside sources from entering the pond.
- Apply lime at the rate of 500 g/decimal before winter.
- Check fish health at regular intervals.
- If it is possible, exchange water regularly.
- Limit use of fertilizer, especially the organic kind.
- Dry bottom of pond every year or every three years.

Topic 5. **Partial Harvesting, Restocking, and Full Harvesting of Fish**

Partial Harvesting and Restocking

In a pond, all stocked fish are not grown at once. With proper maintenance and quality management, some fish grow very fast and some more slowly. After two to three months, some fish will reach a palatable size and can be harvested for eating. This system provides the small fish an opportunity to grow. The number of fish that are harvested should be the same as the number of new fingerlings that are restocked. Maintaining this balance optimizes the carrying capacity of the pond and thereby maximizes production. This method, known as partial harvest and restocking, ensures optimum production so that families can benefit from animal source food for a long time.

Partial Harvesting of *Mola* Fish

Mola fish breeds two to three times a year. After two to three weeks of releasing eggs, *mola* fish should be partially harvested using a seine net at 10- to 15-day intervals. Without partial harvesting, the fish density will become too great, leading to food scarcity. The maximum length of a *mola* fish is 9 cm, but it is palatable at 3–5 cm. Through partial harvesting at regular intervals, the production of *mola* fish is maximized, ensuring a constant fish supply throughout the year.

Full Harvesting

Before fully drying out the water in the pond, fish need to be fully harvested.

Topic 6. **Session Evaluation and Review**

The technical content above should be used to conduct this topic.

Topic 7. **Conclusion and Planning for Next Session**

No technical content is required; FNS Session Guide is sufficient to conduct this topic.

Session 6. Essential Nutrition Actions and Essential Hygiene Actions

Topic 1. **Introduction**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 2. **Key Messages and Practices of Essential Nutrition Actions/ Essential Hygiene Actions**

See SPRING *Community Worker Handbook*, Section 1. Key Essential Nutrition Actions (p7-19) and Section 2. Key Essential Hygiene Actions (p21-25).

Topic 3. **Group Work**

The technical content referenced above should be used to conduct this topic.

Topic 4. **Session Evaluation and Review**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

Topic 5. **Conclusion and Planning for Next Session**

No additional technical content is required; FNS Session Guide is sufficient to conduct this topic.

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