

**VOCATIONAL HIGHER SECONDARY
SECOND YEAR**

AQUA CULTURE



**Government of Kerala
Department of Education**

2006

State Council of Educational Research & Training (SCERT)

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Type setting by:
SCERT Computer Lab.

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Department of General Education
2006

Preface

Dear Teachers,

In the context of the changing scenario in the field of education, the role of the teacher is not simply teaching the syllabi. The emerging needs of education calls for a facilitator's role from the teachers. The learning process has to be student centred and activity - based. Learning activities must enable the student to develop process domain and multiple intelligence skills to their maximum extent.

This sourcebook has been written primarily for the benefit of teachers who teach **Fisheries- Aquaculture** at Vocational Higher Secondary level. The subject matter has been dealt with in such a way as to enable the teacher to provide suitable learning activities for effective learning. The success of the approach depends upon the vision and commitment of the teacher. It is also expected that the teacher has to seek help from other sources like reference books from libraries, websites etc.

Hope that this sourcebook will help the teacher to develop the skills and experience required for effective classroom transaction.

With regards,

Thiruvananthapuram

E. Valsala Kumar

July. 2006

Director SCERT, Kerala

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GENERAL APPROACH

SIGNIFICANCE OF VOCATIONAL EDUCATION

The ultimate aim of education is human refinement. Education should enable the learner to formulate a positive outlook towards life and to accept a stand, which suits the well being of the society and the individual as well.

The attitude and potential 'to work' has determined the destiny, progress and cultural development of the human race. The objective of education is to form a society with individuals having a positive work culture. The educational process expected in and outside our formal schools should concentrate upon inculcating concepts, abilities, attitudes and values in tune with this work culture. Hence vocational education cannot be isolated from the main stream of education. In another sense, every educational process should be vocational. However our inability to utilize the resources wisely and scarcity of job opportunities are a severe issues of the present society. For overcoming this deep crisis, emergent techniques has to be sorted out and appropriate research have to be seriously carried out. It is in this sense that the content and methodology of Vocational Higher Secondary Education have to be approached. The need for meaningful linkages between the world of work and world of education is well recognized. The essence of the recommendations made by various commissions and committees is that vocationalisation should be the main feature of the future system of education at the higher secondary stage; it can be extended to school level also. Vocational education intends to create various skills in different occupations comprising several areas of activities.

The Vocational Higher Secondary Course was envisaged as a part of the National Policy on Education with the noble idea of securing a job along with education. The relevance of vocational education is very great in this age of unemployment. This education system, which ensures a job along with higher education, stands aloof from other systems of education.

This education imparts the life skills required by the youth to enter the world of work and assume the responsibilities of adulthood. As per the expert meeting report (2001) of UNESCO, the life skills are grouped under 4 categories.

They are

1. Skills for personal fulfillment
2. Skills for living in society
3. Skills for dealing with changing economies

4. Skills for dealing with changing work patterns.

Vocational Education ensures fulfillment of manpower requirement for national development and of social security for the citizens through self-employment. It also helps to reduce the migration of rural youth to urban areas and thus helps in rural development.

The learners of Vocational Education get an opportunity to avail one year apprenticeship training in industries to improve their practical skill. During the course of study, on the job training (OJT) for 10 days in a year is arranged to improve the skill and efficiency of the learner. This education system motivates the attitude towards self –employment through Production Cum Service Training Centers. (PSTC)

OBJECTIVES OF VOCATIONAL EDUCATION

The National policy on education has accorded very high priority to the programme of vocationalisation of education, considering the following objectives.

- ❑ To fulfill national goals of development and eradication of unemployment and poverty.
- ❑ To impart education relevant to increased production and productivity, economic development and individual prosperity.
- ❑ To make available skilled work force at all levels to alleviate the rural unemployment and for the development of nation.
- ❑ To develop environmental awareness to ensure sustainable development.
- ❑ To develop vocational aptitude, work culture, values and attitudes of the learners so as to enrich the productivity of the nation.
- ❑ To develop entrepreneurial competencies and skills of learners for self-reliance and to undertake gainful self-employment.
- ❑ To facilitate the expansion of higher education and explore future opportunities through innovative guidance and programmes.
- ❑ To develop vocational competencies, creative thinking in the related areas and facilitate training.
- ❑ To create awareness on mental, physical and social health.
- ❑ To acquire awareness about different job areas and to provide backgrounds for obtaining higher level training in subjects concerned.

LEARNING

Learning is construction of knowledge through a continuous mental process. It is advancement through adding and correcting in by comparing the new issues with the previously learned concepts. Learning is an intellectual process rather than mere memorization of facts. Learning is a conglomeration of a variety of activities like problem solving, finding out co-relations, prediction, arriving at conclusions, rational as well as critical thinking, finding applications and grouping for other possibilities. When opportunities are provided for intellectual processes learning will become effective and intellectual ability will get strengthened.

Theoretical foundations of learning

Education is the best device that can be adopted for creation of a new society. It should be democratic in content and process and should acknowledge the rights of the learner. It should also provide opportunity for better citizenship training. The concept of equality at all areas should get recognition in theory and practice. There should be a planned programme of action to develop a sense of nationality, humanness and love against the encroachment of sectarianism of caste and religion. The learner should become cognizant of the implications of privatization, liberalization, globalization etc.

They should develop a the potential to use the acquired learning as a liberative weapon. They should be able to view education and life through the perspective of social well being. A basic awareness of all the subjects needed for life is essential for all students.

The remnants of perspectives formed in us during the colonial period still influence our educational philosophy. The solution to the present day perplexities of the society, which expose education to competitions and marketisation, is only a comprehensive view of life.

It is high time that education is reorganized on the basis of the philosophy of human education. The human approach to education has to reflect in its content, learning process and outlook. The perspective of 'learning to be' and learning to live together as expressed by the UNESCO and the concepts of existential, interpersonal and interpersonal intelligence.

The basis of new approaches to curriculum and teaching- learning process are the developments that took place in the eastern and western of the worlds.

When we place the learner at the center of the learning process, the teaching process has to be changed accordingly. It is the result of the rapid growth and development of Science and Technology and Pedagogy. If we want to undergo the changing process, we have to imbibe the modern hypothesis regarding learner.

- ❑ Great curiosity
- ❑ Good imagination
- ❑ Numerous other qualities and interests
- ❑ Individuality
- ❑ Interest in thinking and working in a free and fearless atmosphere.
- ❑ Interest in enquiring and questioning.
- ❑ Ability to draw conclusions after logical thinking.
- ❑ Ability to express and establish freely the conclusions arrived at.
- ❑ Desire for recognition in the society.
- ❑ Determination to face the interference of society and make components which is a part of social life.

When we consider the learning system, the domain to be stressed in education according to the modern development becomes relevant. The knowledge domain consists of

- ❑ Facts
- ❑ Ideas
- ❑ Laws
- ❑ The temporary conclusions and principles used presently by scientists.

Learning is a process. The continuous procedures we undergo to reach a particular goal can be called process. The skills that are parts of the process to analyze the collected ideas and proofs and come to a conclusion is called process skills. Some important *process skills* are,

- ❑ To observe
- ❑ To collect data and record
- ❑ To classify
- ❑ To measure and prepare charts
- ❑ To experiment

- ❑ To predict
- ❑ To recognize and control the variables
- ❑ To raise questions
- ❑ To generalize
- ❑ To form a hypothesis and check.
- ❑ To conclude
- ❑ To communicate
- ❑ To predict and infer
- ❑ To use tools.

Observation is the process of acquiring knowledge through the senses. It is purely objective oriented. Learning experiences, which provide the opportunities to use all the senses.

The process of grouping is known as classifying. Starting from simple groupings of data, it can extend to the level of classification into minute sub-groups.

In addition to this, consider the skills related to creative domain also, they are skills:

- ❑ To visualize
- ❑ To connect facts and ideas in new ways.
- ❑ To find out new and uncommon uses of objects
- ❑ To fantasize
- ❑ To dream
- ❑ To develop creative isolated thoughts

Creativity is an essential component of process and activities. The element of creativity is involved in finding out problems, formation of hypothesis, finding 'solutions' to problems etc. Through activity oriented learning experiences, opportunities to express creativity can be created.

Again, the following factors included in the *Attitudinal domain* deserve special mention.

- ❑ Self-confidence
- ❑ Love for scientific knowledge
- ❑ Attitude to know and value history

- ❑ Respect human emotions
- ❑ Decide with reasonable present problems
- ❑ Take logical decisions regarding personal values

'Hypothesis' is a temporary conclusion drawn using insight. Based on knowledge and experiences relating to the problems the causes and solutions can be guessed.

As regards the **application domain** the important factors are the ability to:

- ❑ observe in daily life examples of ideas acquired.
- ❑ take the help of scientific process to solve the problems of daily life.
- ❑ choose a scientific life style
- ❑ connect the ideas acquired with other subjects.
- ❑ integrate the subjects with other subjects.

Some basic stands have to be taken on the new scientific knowledge about intelligence learning and teaching. When such basic concepts are accepted changes are required in the following factors.

- ❑ The vision, approach, structure and content of the curriculum.
- ❑ The vision, approach, structure and content of the textbooks.
- ❑ Role of the teacher and the learner.
- ❑ Learner atmosphere, learning materials and learning techniques.

Some scientific perspectives accepted by modern world in educational psychology are given below.

Constructivism

This approach puts points out that the learner constructs knowledge. New knowledge is constructed when ideas are examined and practiced in new situations relating them with the previously acquired knowledge and experience. That is assimilated into the cognitive structure of one's knowledge. This method, which gives priority to critical thinking and problem solving, provides opportunity for self-motivated learning.

Social Constructivism

Social constructivism is a sub section of constructivism. Knowledge is formed, spread and imbibed and it becomes relevant in a social environment. Interactive learning, group learning, co-operative participatory learning, all these are concepts put forward by social constructivism.

The main propounders of constructivism are Piaget, Vygotsky and Bruner.

Discovery learning and interactive learning have prime importance. Learning takes place as a part of the attempt for problem solving. The learner confronts cognitive disequilibria in a learning situation and when he tries to overcome it leads to the renewal of cognitive structure. It is through this process construction of new knowledge and the assimilation of them takes place. Observation and enquiry are unavoidable factors. The learner advances towards new areas of acquisition of knowledge where he tries to compare his new findings with the existing concepts.

Learning is a live mental process rather than the ability for memorization of facts. Cognitive process has to be given emphasis. The process of problem analysis, elucidation, critical thinking, rational thinking, finding out co-relation, prediction, hypothesis formation, application, probing for other possibilities, extracting the crux and other processes are of critical importance in learning.

Constructivism gives greater predominance to co-operative learning. Social and cultural factors influence learning. Sharing of knowledge and experience among learners, collective enquiry, assessment and improvement, group activity and collaborative learning by sharing responsibilities with the objective of public activity, provide opportunity for effective learning.

In learning internal motivation is more important than external motivation. The learner should have interest and initiative in learning. Learning situation should be capable of forming a sense of ownership in the learner regarding the learning process.

Learning is not a linear process. It progresses in a spiraled way advancing deeper and wider.

NEW CONCEPTS OF LEARNING

1. Discovery Learning

The teacher has to create a motivating atmosphere for the learner to discover concepts and facts, instead of listening always. Creating occasion to progress towards

discovery is preferred. Instead of telling everything before and compelling to initiate the models, situations are to be created to help the children act models as themselves.

2. Learning by discussion

Discussion leads to learning is Burner's theory. Here discussion is sharing on the plane of ideas. New ideas are arrived at by seeking explanations, by mutual giving and taking of ideas and by problem solving.

3. Problem solving and learning

Only when the learner feels that some thing is a problem to be solved that he takes the responsibility of learning it. It is an inborn tendency to act to solve a problem that causes cognitive disequilibrium in a particular area. It is also needed to have confidence that one is capable of doing it. The problems are to be presented in consideration of the ability and level of attainment of the learner.

4. Collaborative learning

This is the learning in which the responsibilities are distributed among the members of the group keeping common learning objectives. The common responsibility of the group will be successful only if each member discharges his duties. All the members will reach a stage of sharing the result of learning, equally through the activity with mutual understanding. The teachers who arrange collaborative learning will have to make clear the responsibilities to be discharged. This is possible through the discussion with the learners. Collaborative learning will help to avoid the situations of one person working for the whole group.

5. Co-operative learning

This is the learning in which the learners help one another. Those who have more knowledge, experience and competency, will help others. By this exchange of resources the learners develop a plane of social system in learning also. As there are no high ups and low ones according to status among the learners they can ask the fellow students doubts without any hesitation Care should be taken not to lead this seeking of help to mechanical copying. It should be on the basis of actual needs. So even while encouraging this exchange of ideas, among the members of the group cautious acceptance is to be observed as a convention. There should be an understanding that satisfactory responses should come from each member and that the achievement of the group will be assessed on the basis of the achievement of all the members.

6 Zone of Proximal Development

Vygotsky observes that there is a stage of achievement where a learner can reach by himself and another higher zone where he can reach with the help of his teachers and peers and elders. Even though some can fulfill the learning activity by them there is the possibility of a higher excellence. If appropriate help is forth coming every learner can better himself.

7 Scaffolding

It is natural that the learner may not be able to complete his work, if he does not get support at the proper time. The learner may require the help of the teacher in several learning activities. Here helping means to make the learner complete the activity taking responsibility by himself. The teacher has to keep in mind the objective of enabling the learner to take the responsibility and to make it successful.

8. Learning - an active mental process

Learning being a cognitive process, the teacher needs to know cognitive processes to facilitate the creation of learning opportunities. Learning can be made effective by providing learning experiences involving mental processes like

- Retrieves/recollects/retells information
- Readily makes connections to new information based on past experiences and formulates initial ideas /concepts.
- Detects similarities and differences
- Classifies/categories/organizes information approximately.
- Translates/transfer knowledge or understanding and applies them in a new situation.
- Establishes cause-effect relationships
- Makes connections/relates prior knowledge to new information/applies reasoning and draw inferences
- Communicates knowledge/understanding through different media.
- Imagines/fantasises/designs/predicts based on received information
- Judges /appraises/evaluates the merits or demerits of an idea/develops own solutions to a problem.

9. Intrinsic Motivation

Intrinsic motivation is given more importance than extrinsic motivation. The teacher has to arouse the internal motivation of the learner. A person internally motivated alone can immerse in learning and own its responsibility.

10. Multiple Intelligence

The theory of multiple intelligence put forward by Howard Gardener has created a turning point in the field of education. The National curriculum documents has recommended that the curriculum is to be designed taking into consideration of this theory. Main factors of the intellect:

1. Verbal/linguistic intelligence- Ability to read and write, making linguistic creation, ability to lecture competence to effective communication, all these come under the this. This can be developed by engaging in language games and by teaching others.
2. Logical/mathematical intelligence - Thinking rationally with causes and effect relation and finding out patterns and relations come under this area. Finding out relations, explaining things, sequential and arithmetical calculations etc. are capable of developing this area of intelligence.
3. Visual/spatial intelligence - In those who are able to visualize models and bringing what is in the imagination into visual form and in philosophers, designers and sculptors this area of intelligence is developed. The activities like modeling using clay and pulp, making of art equipments, culture and giving illustrations to stories can help the development of this ability.
4. Bodily Kinaesthetic Intelligence - The activities using body language come under this. This area of intelligence is more developed in dancers and actors who are able to express ideas through body movements and in experts in sports, gymnastics etc.
5. Musical Intelligence - This is an area of intelligence, which is highly developed in those who are able to recognize the different elements of music in musicians and in those who can hear and enjoy songs. Playing musical instruments imitating the songs of musicians, listening silently to the rhymes and activities like this are capable of developing this area of intelligence.

6. Interpersonal Intelligence - Those in whom this area is developed show qualities of leadership and behave with others in a manner. They are capable of understanding the thought of others and carrying on activities like discussion successfully.
7. Intra-personal Intelligence - This is the ability to understand oneself. These people can recognize their own abilities and disabilities. Writing diaries truthfully and in an analyzing way and assessing the ideas and activities of others will help developing these areas of intelligence
8. Naturalistic Intelligence- A great interest in the flora and fauna of the nature, love towards fellow beings interest in spiritual and natural factors will be capable of developing this area.
9. Existential Intelligence - The ability to see and distinguish our own existence as a part of the universe, ability to distinguish the meaning and meaninglessness of life, the ability to realize the ultimate nature of mental and physical existences, all these are the peculiarities of this faculty of intelligence.

EMOTIONAL QUOTIENT

The concept of emotional intelligence put forward by Daniel Goleman was used in framing the new curriculum. The fact that one's Emotional Quotient (E.Q) is the greatest factor affecting success in life is now widely accepted. The teacher who aims to focus on improving the emotional intelligence of students needs to concentrate on the following.

i) Ability to take decisions

Rather than imposing decision on students while planning and executing activities, the students may be allowed to take part in the decision making process. Taking decisions through open discussion in the class, inviting students suggestions on common problems etc. are habits to be cultivated.

ii) Ability to reach consensus

- When different opinions, ideas and positions arise, the students may be given the responsibility to reach a consensus.
- Imagining what would be the course of action in some situations, allowing to intervene in a healthy way in problems between individuals.

iii) Problem solving

- Developing the idea that there is reason and solution to any problem.
- Training in finding reasons for problems.
- Suggesting solutions through individual or group efforts.
- Discussing social problems.
- Analyzing the shortcomings in methods to solve problems.

Whether plastic can be banned within school premises can be given as a problem. Group discussion will provide reasons and solutions. Problems, which can influence classroom learning and for which the learner can actively contribute

Solutions need to be posed

- Self criticism, evaluation
- Ability to face problem-situation in life
- Thinking what one would do if placed in the situation of others, how one would respond to certain experiences of others - All these foster the growth of emotional intelligence.

iv) Life skills

Life skills need to be given a prominent place in education. W.H.O. has listed: skills required for-success in life.

- Self awareness
- Empathy
- Inter personal relations
- Communication
- Critical thinking
- Creative thinking
- Decision making
- Problem solving
- Coping with emotion
- Coping with stress

The new curriculum addresses these areas.

Knowing the characteristics of the learner, role of the teacher and how to use the teacher's handbook help the teacher to plan and effectively implement learning activities.

ROLE OF A TEACHER

In the earlier approach the teacher was mainly depending on the lecture method for teaching. But in the new method of education the student centered approach is given more importance than the teacher centered approach. Under this changed scenario the teacher has to perform the following roles in the classroom.

The teacher should be

- A facilitator of learning
- A guide to the overall development of the student
- A good observer and motivator
- Able to consider the activities, needs, special features and age group of students at higher secondary level.
- Able to understand the limitations of learner and their learning problems.
- An instructional material developer
- A good communicator
- An innovator
- Able to raise leadership qualities and self confidence of the learner
- An authoritarian in the concerned subject
- Able to arrest and sustain the attention of the learner
- Able to bring out and encourage the inborn talents.
- A resource manager to ensure the optimum utilization of resources.
- A systematic record keeper
- A controller to issue guidance to the students
- A person with high level of practical competency
- Able to correlate area of study with familiar environmental situations
- A self evaluator and good listener
- Able to create awareness in social problems
- A person with democratic and humanitarian approach

- A professional as well as a philosopher
- A good evaluator
- A good organizer and a friend.
- A co-learner as well as co-researcher
- Able to give assistance and advice in placement needs and self employment by giving moral and technical support
- Able to keep moral values
- A person equipped with skill for using new techniques of learning
- Optimistic and impartial

CHILD FRIENDLY CLASS ROOM ATMOSPHERE

Learning can be effective and enjoyable only when the class atmosphere is according to the new conception of learning and the characteristics of higher secondary learner.

- Class and seating are arranged in an attractive way
- Democratic nature is upheld
- Always active
- Students interact with teachers without fear
- Opportunity for a variety of activities
- Students allowed to involve interesting group activities
- Learning speed, learning style and differencing levels of attitudes are considered. Help is extended whenever needed.
- Sufficient instructional materials are available
- There is freedom of expression, students share their ideas and experiences
- Students are given acceptance and encouragement
- Healthy atmosphere
- Needs of each student is given consideration. Happy and energetic atmosphere
- Teachers work considering the rights of students
- Problems handled in a patient way
- Teachers look at all events from the student's view point

There will be students of various ability levels in any class because learning style, learning speed, varying exposure to language experiences, physical and psychological problems and varying socio-cultural background.

The learning experiences provided must help to bring the low activities to an expected level and extended the breadth and depth of the skills of the high activities.

By repeating experiences, introducing variations in a learning experience to suit different levels and if needed, formulating additional experiences the problem of varying ability levels can be tackled.

LEARNER

The learner in second year has undergone a learner centered and process oriented learning experience up to first year. The learner at this age is in awakening stage and he is enthusiastic about environment. He needs recognition and encouragement from environment and also recognize as a grown up man. He is adequately competent to select vocational subjects according to his aptitude and interact and to acquire higher education and profession as he wishes. The aspiration about future life is framed in this particular age for seeming national and international job opportunities. Some of the peculiarities of learner at this stage are;

- Physical, intellectual and emotional planer are intensive changes during the age and their reflections can be observed
- Ability to enquire discover and establish cause effect relationship between phenomena
- Headiness to undertake challenges
- Capacity to shoulder leadership roles
- Attempt to interpret oneself
- Susceptibility to different pressures
- Doubts, anxieties and eagerness about sex
- Imaging for social recognition

NEEDS OF LEARNER

- To make acquaintance with a job or self employment through vocational education
- To acquire more knowledge in the concerned area through higher education
- To recognize and encourage the peculiar personality of the later adolescent period
- To enable him to defined against the unfavorable circumstances without any help

ROLE OF LEARNER

- Active participant in the learning process
- Act as a researcher
- Sharer of information
- Sharer of responsibilities
- Collect information
- Jakes leadership
- Involves in group work
- Act as a co-participant
- Observes his environment
- Experiments and realize
- Make interpretations and draw inferences
- Mould himself in to an active contributor for the welfare of the society

EVALUATION

In vocational higher secondary education, a new approach to education and evaluation should be made. Evaluation must be a systematic and continuous process. As the curriculum is based on vocational stream, capacity building is a most important part and it should be evaluated accordingly. The technical skills, interest in the particular field, communication skill, analysis organizing and presentation skills etc has to be evaluated. The personal and social qualities also have to be evaluated. Therefore, evaluation should be transparent, continuous and comprehensive.

SUPPORTING SYSTEM

In learner centered vocational education, a learning methodology has to be organized and a proper learning atmosphere is to be provided. Many organizations can support the learning activity. They are: -

1. School Resource Group (SRG)

Comprising all teachers (vocational and non vocational) instructors, and lab assistants with academic head as the group leader.

2. School support Group (SSG)

Comprising PTA president, members of local bodies, members of social clubs, subject experts etc who can contribute guidance /technology /infrastructure /financial assistance etc.

3. Parent Teacher Association (PTA)

Can provide adequate funds for field trips, production cum training centers (PCTC), exhibition, On Job training (OJT) etc.

4. Local bodies

Grama Panchayat, district panchayat and block panchayat can provide infrastructure ie, class rooms, laboratory, library, seminar hall, audiovisual equipment etc.

5. Subject club

All vocational teachers handling same vocational subjects should form a subject at regional level or district level. This will help to share the knowledge and practical facilities, production and marketing of materials, service etc.

- Based on the excellency, district wise nodal schools may be selected to provide facilities like central library, museum s, video conferencing etc.

6. Institution Industry Interaction Project (III P)

This should be implemented in every institution to update knowledge this also helps for OJT, PSTC and field visit.

MONITORING SYSTEM

Education is a kind of journey from darkness to light satisfying the needs and the wants of the individual and the society. The modernization of education through activity-oriented system enhances freethinking and working in a fearless atmosphere. It is a qualitative process not a quantitative one this necessitates a proper monitoring system. The system of monitoring should have the following features.

1. It must be transparent
2. It must enrich the ideas of the facilitator through innovative process
3. It must be time bound and rational
4. It must motive the facilitator to adopt new strategies
5. It must be recorded and ensure effective feedback for the effective monitoring of the system, three levels of the mechanism should be setup.
 - School level monitoring group
 - Regional level monitoring group
 - State level monitoring group

Moreover a social auditing system is advisable to attain the objective effectively.

FEATURES OF LEARNING PROCESS IN THE NEW SYSTEM OF EDUCATION

In the new system of education the learning process should be modified in such a way as to enable the learner to construct the knowledge of his own through observation, co-operation, problem solving, social interaction etc. The learning process should consider the nature ability, social setup, inborn talents and subject selected by the learner. Therefore the learning process should be,

- A continuous mental process
- Simple learner must feel that he is able to undertake the task
- Enable the learner to attain the curriculum objective
- Interesting
- Suitable to the age and attitude of the learner
- Future possibilities
- Enable group activity

- Challenging
- Time bound
- Constructive and curiosity developing
- Possibilities for evaluation
- Capacity to generate independent thinking
- Ability to enquire discovers and establishes cause effect relationship between phenomena.

LEARNING AIDS

To make the teaching and learning process simple and effective, certain learning aids and necessary use of such aids are transacting a complex idea makes the classroom live and students get more and more involved. The advances in science and technology may be effectively utilized for this purpose. Some of the learning aids listed below.

- Multimedia
- Over Head Projector
- Computer
- Internet
- Liquid Crystal display Projector
- TV, VCD, DVD and tape recorders
- Working models
- Charts
- Slides
- Video Conferencing facility
- Library
- Text book
- Source book

SOCIETY

The new educational policy uplifts the social commitment of the learner. Therefore the society can also give some valuable contributions in this changing situation. The new system also ensures that the learner can perform certain useful

services for the betterment of society. The social obligations can be illustrated as follows.

- To enrich social values, aptitude and ability in learner
- To develop entrepreneurial aptitude and ability which helps social welfare and self employment
- New system of education adopts OJT, PSTC etc is a part of vocational curriculum, which helps to make close contact with the society.
- The resources available from our society can be positively utilized to convene seminars, interview etc.
- Social organizations can help learners to make their education socially committed.
- The social clubs like NSS, Tourism club, CDO club, energy club etc functioning in schools can make direct link with the society.

FISHERIES APPROACH

Man has constantly been trying to explore the universe for providing himself with food, clothing and housing. These days the problems of food has become very drastic and it is being felt that supplementing agriculture could develop the main weapon in war on hunger. Fisheries are one of the important allied activities of agriculture sector. It is regarded as a powerful income and employment generator as it stimulates the growth of a number of subsidiary industries. This is also a foreign exchange earner besides providing balance protein food to all classes of people.

India possess ideal conditions for improvement of fisheries. In spite of various advantages of fish as a valuable source of food, its availability is rather restricted in India on account of limited fishing industry. Till recently fishing and allied activities were restricted with certain sector of population. Boats, nets and tackles are what were devised centuries ago and are made by hands while other countries have marched much ahead with modern techniques. Organisation of fishing industry on modern line will go a long way in solving the food problem in the country and improving the lot of the fishermen who constitute a significant part of India's population.

One of the important objectives of fisheries development has been improvement of economic condition of fishermen who are the prime producers.

One of the best ways to uplift the fisher folk is to eradicate illiteracy and to give awareness about new techniques developed in fishing and allied industries.

Today fisheries have been incorporated in our education system as a subject at various levels. Here our approach is to teach fisheries as a vocational subject to transfer the scientific and technical know how to learners, which will empower them to transfer the knowledge to fisheries sector and modernise it.

‘Give a man a fish
He will eat only once.
Teach him fish culture
He will eat throughout his life’

This Chinese proverb says all about the significance of aquaculture studies as part of vocational education. wide lacuna is existing between the capture fishery from the natural water bodies and the demand of the ever-increasing population for nutrition for combating mal nutrition. Though our present production through inland and marine water has increased to about 4 million tones per year, our present requirement is more than 10 million tones. At this juncture ,the importance of aquaculture is greatly felt as that of agriculture and animal husbandry.

Aquaculture can be regarded as man’s attempt through inputs of labour and energy to improve the yield of useful aquatic organisms by deliberate manipulation of their rate of growth, survival and reproduction on captivity. The technique of Aquaculture involve both management of soil and water and husbandry of fish. Management of soil and water basically the same as in agriculture, and fish husbandry as in livestock farming. Besides fish provide high quality food rich in protein ,vitamins and contain poly unsaturated fatty acids, calcium, phosphorous and other nutrients necessary for human health and growth.

Aquaculture is undertaken in different ways in different ecosystems. It is essential to have a clear understanding of the system of culture to utilize fully the available ecological niches. The students dealing with the fisheries aquaculture course is exposed to a wide range of aquaculture such as selection of site of fish and shell fish, construction and preparation of various types of ponds, different culture systems control of aquatic weeds, predatory and weed fishes, seed production and

their transportation, culture of live food organisms, fish nutrition ,disease and their control etc

Further aspects like water recirculation system, integration of aquaculture with live stock and agriculture, ornamental fish culture and sewage fish culture are also dealt with this course. This source book can serve as a reference for fisheries student, fish farmers and extension workers associated with aquaculture.

LEARNING STRATEGIES

In the modern era of globalization the introduction of new technologies ensure only the survival of the fittest. So it becomes a necessity to equip the leanness to face the growing challenges in the competitive world. Hence the traditional approach to learning is no more relevant in the present context. The teacher should use instructional techniques that motivate the students to construct his own knowledge. Now the learners are not passive listeners, but they are the active participants in the construction of knowledge. Here the teacher – student interaction should be given much importance.

In the new instructional strategy while selecting the methods of teaching, the social and psychological aspects of the learner is to be taken into consideration. The given activities for learning are only suggested ones. It can be altered according to the discretion of the teacher.

To obtain the objectives, the new system of education is introduced in the Vocational Higher Secondary Education for attaining the objectives of the courses in this system, we can adopt the following strategies.

I. Assignment

Assignment is some specific work assigned to the students as a part of their academic enrichment. There are learning activities undertaken as a continuation of class room activities to realize the curriculum objectives to a broader extent . They should be completed in time bound manner. They help to lead learner to higher level of learning from the present status. Challenging assignment can motivate the students to involve in group dynamics and achieve fruitful results. The teachers may at as a guide.

Assignment may be given on individuals or group basis. Assignment includes preparation of notes, preparation of charts, models, collection of materials from institutions etc. Assignments develop skills of reference, observation, enquire reporting etc. It ensures the effective utilization of leisure time of the students.

II. Seminar

Seminar is a learning strategy involving an in-depth analysis of specific topic, preparation of a paper and presentation . The paper is presented by either one student or a group of students. After the presentation, there will be a discussion/ interaction in which all the students can participate . The students get an opportunity to clear their doubts and make clarification. Seminar helps to develop communication skill and overcome stage fright.

Stages

1. *Selection of Topic*: The topic of seminar should be relevant to the subject of study
2. *Assignment of topic to individuals students or team*: The topic may be assigned to one student or to a group of students.
3. *Collection of relevant information*: Information required for seminar can be collected from various sources namely books, magazines, internet, institutions, place and persons.
4. *Preparation of draft paper*: Based on the information collected the student may prepare a draft paper and submit it to the teachers for comments. Revise the draft paper based on the comments of the teachers. The refined draft is submitted for approval.
5. *Program scheduling*: The date, time and venue of the seminar is fixed. A seminar leader may be selected from the students
6. *Seminar paper presentation*: The student/ students shall present the paper in the seminar. The teacher may function as the moderator during the initial stages.
7. *Discussion / Interaction*: A number of respondents from the students make comments on the topic. This will be followed by a general discussion. All the group members should actively participate in discussion.
8. *Summing up deliberation*: The moderator sums up the deliberation
9. *Evaluation / Feed back*: Both teachers and students evaluate the programme.
10. *Preparation of final report*: A final seminar report is prepared covering all the additional points discussed and consolidated.

III. Panel Discussion

It is a learning strategy in which a panel of experts are allowed to discuss a specific subject under the control and direction of a moderator. Subjects can be divided according to the number of panel members. Number of panel members are fixed according to subdivision of points in the subject. Relevant materials and handout may be given in advance to the learners. The monitor or moderator introduces the subject of discussion and invites a panel member to start the discussion. Each panel member is invited for discussion afterwards. After briefing by the panel members the questions are raised from the audience and the panel members give suitable answer to them. A report should be submitted by each learner to the moderator.

IV. Project

Project is a self-learning strategy which can exert great influence on the overall development of the learner. Project as learning strategy is to be selected where a problem arises in any part of the curriculum. The students may be divided into groups and assigned different aspects of the problem. Each group works independently. Specific aspects of the problem such as data collection, classification, analysis, report preparation and presentation is to be undertaken by each of the members. Even though the work is divided among the members, it must be ensured that the execution of each and every activity is done with the active participation of all. After analyzing data collected from different sources, the learner arrives at a conclusion that can help to solve the problem. Thereby learner learns the topic through his own activity. The other advantage of this learning activities is that it helps the learner to scientifically handle any problematic situation. It helps in the development of scientific thinking and thereby builds up the students aptitude for the subject.

Stages of the project

1. Selection of a topic

The project selected should be related to the curriculum and it should not be a project for projects sake. The topic or problem should arise from the curriculum.

2. Planning of the Project

- (a) Hypothesizing: Hypothesizing means making assumptions based on the available primary information.
- (b) Methods and Technique : The methods and Technique should be based on the aim and Hypothesizing of the Project. The nature of the project, suitability of the tools, and the methods of learning should be related to each other.

3. Collection and Tabulation of Data

The data may be primary, secondary or tertiary. Either census or sampling method can be used based on the objective of the project. Suitable questionnaires are to be prepared for the collection of primary data.

The collected data is to be classified and tabulated so as to make it easily understandable.

4. Analysis of data and formulation of conclusion

By analyzing the data, the reliability of the hypothesis can be examined. Preparation of graphs and diagrams and maps will positively help the analysis. The similarities, relations and differences gathered from the analyzed information would tell whether the hypothesis should be accepted or rejected.

5. Preparation of Report

The cover page should have the title of the project, the period of study, name (s) of investigator/group, and the address of the school. The report should be structured in the following order.

1. Title
2. Preface
3. Hypothesis and aim
4. Methodology
5. Sources of data
6. Analysis and conclusion
7. Suggestions (if any)
8. References
9. Appendices (Questionnaire, Observation schedule, check list Etc.)

6. Presentation of the Project

When the project is presented , the learner is being evaluated and accepted. It is through this presentation that ideas are shared with others in the class and society.

The project methods promotes scientific self learning and makes him capable of solving the problem arising in real life situations.

V. Debate

Debate is a hot and interesting learning activities. A debate can be organized only on a topic on which there is difference of opinion. Therefore a topic suitable for debate has to be chosen.

Debate can be on relevant topic that is different and interesting to the students and relevant to society. Students with different opinions have to be identified for discussion. Those who have similar opinion should join together to form a side . Those who hold the opposite view with form the other side. It would be ideal to write down the topic of the debate and displayed in advance. There should also a person to control debate.

Students should be given opportunity to absorb the ideas obtained from discussion and debate, develop the idea through reading and study, and to express them through writing or other means

Stage of Debate

1. Topic Selection
2. Selection of panels keeping in balance with intelligence, gender etc.
3. Selection of moderator
4. Collection of information guided by the teacher
5. Conducting the debate under the control of moderator by avoiding any sort of personal conflicts
6. Conclusion by the moderator expressing his final version or verdict.

VI. Case Study

A case may be a person, institution or a community case study is an in-depth analysis of an actual event or situation. It presents real pictures of situation with facts, objective information or data. Learners analyse the case to interpret, predict and resolve issues associated with it. The case study provides the learner an opportunity to analyse and apply concepts, data and theory taught from the class. Learners can work individually or in groups.

By studying realistic cases in the classroom, students develop new insights into the solution of specific on – the – job problem and also acquire knowledge of the latest concepts and principles used in problem solving.

Case may be presented by the teachers or may be provided in print form.

A simple case study may have the following steps

1. Collection of data
2. Conversion of data into information
3. Analysis of the case in groups
4. Presentation of the finding by each group leader.
5. Evaluation

In addition to the above mentioned learning strategy there are many other learning strategies which can be used in appropriate situations to enrich learning process such as problem solving, Role play, brain storming, debate etc.

VII. Brain Storming

This is the best method for solving creative problems. It facilitates generation of ideas quickly. Rules for conducting Brain storming.

1. No response is wrong. So welcome every response.
2. Welcome as many responses as possible

3. No criticism is allowed
4. Allow to work on others idea

Steps in Brain storming

1. Presentation of the problem
2. Provide relevant information
3. Record the ideas put forth by the participants
4. Combine similar ideas
5. Evaluate each idea and solution
6. Selection of the best solution

If brainstorming is used as an instruction strategy, the last step is not essential

VIII. Discussion

Discussion is essential for the student to share new finding, idea and conclusion at each stage of learning with fellow students and teachers. In general discussion the teachers should guide the discussion through questioning and summarizing. The major steps involved are

1. Introduction initiated by the teacher
2. Development of discussion by giving lead points and follow up interactions
3. Transaction stage in which the key points are reviewed by the teacher and
4. Summarizing stage in which teacher provides additional support materials to ensure the achievement of the objectives

IX. Group Discussion

Group discussion is an ideal method to develop cooperation, democratic attitude, friendliness and compromising attitude which are the ultimate aims of education. During group discussion the teacher may observe each group and it needed help them to channel the discussion towards the common objectives. All students may be given opportunity to take part and express their ideas within a time limit. The conclusion reached may be entered by each student. A group representative must present this during consolidation in which the teacher may correct or add informations to ensure that all the relevant ideas have been covered

X. Collection

Collection is a continuous learning activity, which ensures complete participation of students. The collected item may be materials, pictures, charts, ideas, data etc.

Collection provides direct experience to learn. An exhibition of collected materials will help to strengthen the concept.

XI. Practical works

Experimentation contains the process skill in an integrated way. In the new approach of curriculum the student forms idea and comes to conclusion through process. The term 'Practical' when associated with a science subject usually means an experiment. The objective of doing an experiment is to explore new ideas through investigation only. Its main purpose is to verify some principles associated with theory. The subjects end here. But this is not the case with 'Vocational Practical'

The ultimate goal of a Vocational Education is to generate skill through continuous practice along with investigation and invention. Continuous practice transforms the unskilled to the skilled. This is the significance and importance of practical in the Vocational stream. Hence it is very crucial that Vocational teachers as well as instructor should understand the importance of vocational practical and act accordingly.

XII. Quiz

Quiz programmes can be used as an interesting class room tool for transaction of curriculum objectives as well as to evaluate the effectiveness of transaction and achievement of students.

For conducting a quiz programme a topic should be selected based on the above objective

The students are asked to prepare questions based on the topic individually. The next day / next hour the students are grouped into 3-4 groups randomly. A question is raised by a particular team and the other teams to answer them if they can answer the question they get points for that if all other teams fail to answer the question raised by the 1st team the 1st team answer the question and explain the background if necessary. All the teams get equal number of chances to ask the question. Time limit is also prescribed for the conduction of the programme. The team who scores maximum points wins

All the participants can make notes on the questions asked, answers and their explanations which help them in learning

XIII. Models

Models are used in learning process. It enhances the learning experience. This is based on the 'seeing is believing'. It helps the learner a chance to see feel the model presented. Still models and working models help the students to understand the structure, working principles, actual operation etc.

Several steps are involved

1. Locating the problem
2. The teacher should plan the type of model according to co's
3. Grouping the students
4. Briefing the tasks
 - Aim
 - Need
 - Material required
 - Source & Materials
 - Cost of materials
 - Division of Labour
 - Guidance
 - Fixing of a time limit
5. Presentation by each group about
 - How the models were prepared
 - Details of - Expenses
 - Working and principles
 - Finally documentation of the process
6. Evaluation
 - By the other groups
 - Later a consolidation by teachers are to be done.

XIV. Games

Class rooms can be made attractive by introducing different types of games. Games should be interesting as well as informative. Some of suitable games are

1. Odd man out
2. Cross word puzzles
3. Match the following
4. Aswamedham
5. Link game – Answer using clues.

XV. Survey

This strategy involves collection of data from the group under study (book, person, materials etc.) It develops the social interaction and communication ability of the learner. It also provides a scope for discovery learning.

Step involved in survey

- 1 Objective of survey
- 2 Selection of area for survey/sampling frame
- 3 Selection of survey method

Direct method

With help of questionnaire/schedule

- 1 Tabulation and analysis
- 2 Consolidation and Presentation

XVI. Exhibition

It is a learning strategy by which the learner can get a chance to show the skill developed. It provides the intrinsic motivation and exposure.

Exhibition item can be conducted either individually or as a group task. It can be conducted at school / Regional/State/National level. Necessary publicity and other arrangements can be provided. Presentation, documentation, participation and innovative skills of the learner can be evaluated.

XVII. Interview

Interview is one of the important learning strategies taking the help of a resource person. Interview is an inner view. It provides opinion and information about a topic.

An interview is conducted by the following steps

1. How to introduce a problem?
2. Invite a resource person
3. Decide the questions by learners
4. Decide the time, place etc.
5. How to discuss?
6. How many students to participate?
7. Implementation of the interview
8. Conclusion (Facilitator)

Items required

- 1 Interview Schedule
 - 2 List of questions prepared by learners Selection of students, selected names sequence of question
-

XVIII. Field Visit

Field visit is an inevitable vocational tool to be implemented in vocational Higher Secondary Education. This helps the students to familiarise with the modern technologies and new situation in a different atmosphere. It provides learning through viewing. It is based on the principle that seeing is better than having. It enables the learning to retain the learned information longer and to make the subject more interesting. It motivates and gives more confidence in his/her particular vocation.

The facilitator should identify suitable center/ institution/site. Get prior permission from the authorities before conducting the field visit. Give instructions to the learners for collection data/information/materials/specimens. Teacher may assign different duties to learners by working them in different groups.

Each learner should take utmost care and interest during the visit. He/She should observe and interact at the center/ institution where the field visit is conducted.

After the visit, learner should acquire the ability to apply the ideas/concepts in his future carrier. Each learner should submit a detailed report about the field visit.

XIX. Demonstration

Through demonstration we can present an item/product and emphasize its features very effectively.

Eg:- To understand the functioning of a computer

1. Material/Item/Process
2. Demonstration
3. Venue
4. Additional requirements depending upon the nature of the item

Demonstration Process

1. Introduction about the item/Material
2. Principles – Working
3. Operation
4. Components
5. Merits of the item

XX. Chart display

It is also one of the important teaching aids. It can be used in every activities of a learning process.

Chart display is a written or pictorial representation of idea or concept. It is abbreviated, brief and clear. It is prepared by study

Benefits

1. A learner gets clear idea about the concept
2. The learner can retain the ideas in his mind for longer periods
3. A complicated idea can be simplified through a chart
Cheap method of teaching aid.

CURRICULAR OBJECTIVES AND SYLLABUS

Curricular Objectives

- To familiarize with brackish water and the ecology of brackish water ponds through discussion .
- To create an awareness of the soil characteristics of brackish water bodies through discussion.
- To identify the flora, fauna and plant-animal complex of brackish water bodies through collection and observation.
- To collect information on different criteria for the selection of site suitable for the
- construction of brackish water farm through discussion.
- To develop skill in the identification of site suitable for the construction of
- Brackish water farm through field survey and field study.
- To get an idea about the compilation of data collected by field survey through discussion.
- To develop skill in the identification of site suitable for farm construction based on field survey through discussion.
- To familiarize with different components of brackish water farm such as dykes , feeder canal ,different types of ponds etc through discussion and fields visit
- To develop an idea about the preparation of selected site for farm construction through discussion.
- To develop skill in the design and lay out preparation through chart/model preparation.
- To acquire idea about the different steps in the construction of farm through discussion.
- To get an awareness about the criteria for the selection of species suitable for brackish water aquaculture through discussion.
- To familiarize with bionomics of cultivable brackish water fish and shell fish through assignment.

- To develop skill in the identification of cultivable brackish water fish and shell fish through collection and observation using charts, specimen and OHP.
- To get an awareness in the induced breeding of fishes and shell fishes through assignment..
- To create an awareness about the induced maturation of shrimps (Eye-stalk ablation) through discussion.
- To develop skill in eye stalk ablation process through practical work.
- To familiarize with the life cycle of penaeid prawn through discussion with the help of chart.
- To acquire knowledge in the criterias for the selection of site for shrimp hatchery through discussion.
- To observe different facilities required for a hatchery complex through hatchery visit/film show and interview.
- To develop skill in the culture of live food for feeding larvae through practical studies.
- To familiarize with the selection of spawner through discussion and chart.
- To develop skill in the larval and postlarval rearing through practical studies.
- To develop skill in the hatchery management through On Job Training(OJT) programme.
- To observe and analyse the merits and demerits of traditional brackish water culture system through field visit, discussion and interview.
- To familiarize with different brackish water culture systems of fish and shrimp through discussion.
- To acquaint with different culture techniques of clams, oysters, mussels and sea weeds through film show and discussion.
- To develop skill in the collection and identification of cultivable molluscs and seaweeds through practical studies.
- To get an awareness on classification of brackish water farm through discussion.

- To acquire knowledge in pond preparation through discussion.
- To develop skill in the eradication of predatory and weed fishes through practical studies.
- To develop skill in liming of pond through practical studies.
- To develop skill in pond fertilization through practical studies.
- To develop skill in seed stocking through practical studies.
- To analyse natural fish food organisms in brackish water ponds through practical studies.
- To familiarize with the nutritional requirements of fish through discussion with the help of chart.
- To develop skill in finding the efficiency of different artificial feeds available in market through project work.
- To observe various diseases and their control through discussion and seminar.
- To collect information regarding various aspects to be considered while harvesting through discussion.
- To observe different steps in harvesting, handling and preservation through film show/field visit and discussion.

Syllabus

Unit 1. Brackish water Fish/Shellfish culture

Ecology of brackish water ponds – water, soil and biota.

Unit 2. Selection of Site

Topography, terrain and elevation, water availability and supply. Water and soil characteristics –temperature, salinity, oxygen, PH, Soil texture and nutrients.

Unit 3. Farm design and construction

Intake point, pump house, main feeder canal, Secondary feeder canal, Peripheral dykes, Secondary dykes, master sluice, reservoir ponds, filtration ponds, stocking ponds, central drainage system, effluent treatment pond

Unit 4 Bionomics of cultivable fish and shellfish

Criteria for the selection of species, identified candidate species of fish and shellfish, biotic potential of candidate species.

Unit 5 Controlled breeding of fish and shellfish

Induced maturation/breeding of mullets, milkfish, prawns and mollusc.

Unit 6 Hatchery Management

Hatchery management for shrimps -hatchery complex-brood stock collection and maintenance, maturation, Spawning, hatching, early larval and post larval facilities, water supply, aeration, culture of larval feeds and disease control.

Unit 7 Culture systems

Traditional culture system. Pond culture –mono culture, composite culture, poly culture, cage and pen culture of fish and shrimps. Culture of mollusks- method of culture of clams, oysters and mussels sea weed culture.

Unit 8 Management of Farms

Complete extensive, semi-intensive & intensive farming. Pre- stocking and post –stocking, management practices- preparation, liming and fertilization and stoking.

Unit 9 Feeds and feeding

Natural fish food organisms, nutritional requirements, artificial feeds and feeding.

Unit 10 Disease management

Parasite and disease problems in cultural species of fish and shellfish. Water quality and disease problems, Nutritional disease and disease control.

Unit 11 Harvesting

Suitable time of harvest, water level maintenance, draining, netting, handling and transport.

PLANNING

The transaction of fisheries curriculum in Vocational Higher Secondary classes has to be made through different but relevant activities. The teacher should plan those activities, which are suitable for the learners to develop the different concepts, skills and elements of multiple intelligences in them. Such activities can be made within or outside the classroom. For the effective, timely and systematic transaction of the curriculum the activities has to be planned well in advance. This will help the teacher to guide the learners to prepare for the activities and to evaluate the process at different stages.

It is necessary that the teacher should prepare an annual plan, unit plan and daily plan for the effective transaction of the curriculum.

YEAR PLAN

An year plan has to be prepared in order to foresee picture of the whole activities to be conducted in the class in an academic year. The year plan is to be prepared by the teacher after examining the curriculum objectives, textbook, source book and other training materials. While preparing year plan the teacher will consider the facilities available in the school, the possibilities of field visits, interviews, seminars, projects, collections, discussions, lab work etc. which form part of the activities of the lessons. Activities are to be arranged by utilizing the local resources available. For systematic and effective transaction of the curriculum the year plan is an important instrument. With the help of year plan the teacher can transact the curriculum systematically within the stipulated time. The year plan included in this source book is flexible in nature and revise and rearrange the activities and create favorable opportunities for providing positive learning experiences on the basis of locality aspects with the support of school support group (SSG) and school resource group (SRG).

While framing the year plan the following points should be kept in mind;

- Field visits of various units can be clubbed together, if there is any practical difficulty in conducting these field visits separately or unit wise.
- The OJT should be conducted before January.

- Types of products and period of operation can be modified on the basis of rawmaterials availability, season, demand etc.

MONTH	UNIT	MAJOR ACTIVITES	HOURS
JUNE	1.BRACKISH WATER FISH /SHELL FISH CULTURE	DISCUSSION COLLECTION FIELD VISIT	25
JUNE-JULY	2.SELECTION OF SITE	FIELD VISIT MODEL PREPARIION	65
JULY -AUGUST	3.FARM DESING AND CONSTRUCTION	ASSIGNMENT DISCUSSION IDENTIFICATION	50
AUGUST	4.BIONOMIC OF CULTIVABLE FISH AND SHELLFISH	ASSIGNMENT DISCUSSION SKILL DEVELOPMENT	30
SEPTEMBER	5.CONTROLLED BREEDING OF FISH AND SHELLFISH	DISCUSSION FIELD VISIT FILM SHOW, SKILL	30
OCTOBER	6.HATCHERY MANAGEMENT	DISCUSSION ASSGNMENT	45
OCTOBER -NOVEMBER	7.CULTURE SYSTEMS	DEBATE SKILL DEVELOPMENT	20
NOVEMBER	8.MANAGEMENT OF FARM	PROJECT SEMINAR DISCUSSION	55
DECEMBER -JANUARY	9. FEEDS AND FEEDING	PROJECT DISCUSSION	60
JANUARY	10.DISEASE MANAGEMENT	SEMINAR	25
FEBRUARY -MARCH	11.HARVESTING	FIELD VISIT, DISCUSSION	15

UNIT PLAN

In order to convey the curriculum objectives to the students, the teacher should make adequate and prior preparation in making classroom transaction effective. In the planning process, unit plan occupies an important place.

In the unit plan the steady growth of the annual plan is reflected. This is the plan of a unit to enable us to complete the activities by interrelating the year plan in a time bound manner with suitable modifications on the basis of local demands and environment. Curriculum objectives, teaching strategies, learning aids, expected outcome, evaluation possibilities etc, are to be decided in advance for unit planning. Each unit plan is attached in concerned units. Teachers can prepare unit plans for every unit by utilizing this as a base. A sample unit plan is given. Find out more and more learning processes and introduces it in the classroom by applying different strategies of teaching and learning.

UNIT -1. BRACKISH WATER FISH AND SHELL FISH CULTURE

CO	Content Area	Activity/ Experience	Materials	Product	Evaluation	Ref
1. To familiarize with brackish water, ecology of brackish water pond through discussion.	Brackish water formation, its sources and advantages as medium for aqua culture.	Discussion	Chart	Notes	Participation in discussion	
2. To create an awareness of the soil characteristics of brackish water bodies through discussion.	Water retentive capacity of soil, nutrients in soil	Discussion	Reference Books	Notes	Participation	
3. To identify the flora, fauna and plant-animal complex of brackish water bodies through collection and observation.	Comparison of flora and fauna of the fresh and brackish water, lab-lab	Collection and Identification	Plankton net, microscope chart	Identification skill, Notes	Participation	

DAILY PLAN

Daily plan is the programme for achieving the curriculum objectives targeted for a day. This gives a detailed plan for each hour. CO's can be included and may be divided on the basis of similarities, ideas and activities. This section can be divided into two parts as process\ learning activities and response. If an activity require more than one day to complete a single daily plan is enough for all these days. Teachers have to plan elaborately and systematically before organizing a class. The success of a class depends on the daily plan. The following points should be kept in mind while framing the daily plan.

- Learning activities should be formulated in such a way for developing the various skills of the learner.
- It should be in accordance with the availability of time, needs of the learner, learning atmosphere etc. (if needed the teacher should club one or more periods)
- Active participation of all the learners should be ensured.
- Learning activities should be challenging, interesting and thought provoking.
- Response part of the daily plan can be completed only after the class.
- Future planning should be based on this feedback.
- The teacher can make use of this part for continuous evaluation.
- In response column the teacher should note about the process/ activities, the learners and the teacher himself.

Daily plan provided here is a simple one. The teacher should prepare daily plans which suits to their classes by considering this sample daily plan as reference.

DAILY PLAN

Name of teacher :
 Name of the unit : Controlled breeding of Fish and Shell fish.
 Name of the class :
 Time : 2hours
 Curriculum objective : To develop skill in eye-stalk ablation process through practical work.
 Learning materials : Shrimps, burner, blade, basins etc

ACTIVITY	RESPONSE
<p>❖ SKILL DEVELOPMENT</p> <ul style="list-style-type: none"> • Discussion with the learners regarding the significance of induced breeding in shrimps. • Discussion about the biology of eye-stalk ablation in shrimps. • Discussion on the importance of unilateral eye-stalk ablation and demerits of bilateral eye-stalk ablation. • Discussion on the hygienic practices to be followed during ablation. • Mention about the management of ablated shrimps. • Teacher should supplement the discussion through asking questions, showing photographs, figures from text books, manuals etc. • Shrimps are collected from nearby source are taken for eye-stalk ablation practice. • Take basin half filled with sea water. • Light the burner for sterilizing the blade before ablation. • Shrimps are taken in the left hand and hold it carefully. Make sure the cephalothorax is not covered with the hand. • Take the blade in the right hand, sterilize it and make an incision on the eye ball of the shrimp. Squeeze the contents out through the eye ball starting from the base of eyestalk. • Place the ablated shrimps in another basin with medicated sea water. • All the learners may be given the opportunity for ablation. 	<ul style="list-style-type: none"> • Boys were participating well • Learners were able to recollect induced maturation process of shrimps studied in the theory classes. • Photographs and figures were inadequate. • Number of shrimps provided were inadequate. • Girls were at first reluctant to handle the shrimp. But later they showed interest in handling and practicing the ablation. • Learners were very much interested in this skill development activity.

EVALUATION

Evaluation is a systematic process of collecting, analyzing, synthesizing and interpreting evidences of students' progress and achievements both in cognitive and non-cognitive areas of learning. Evaluation has to play significant role in making the learning process more effective. It provides diverse experiences to the learners, keeping in view the skill to be attained continuously by them.

As the curriculum is based on a particular vocation the selected stream is the most important part and it should be evaluated accordingly. Technical skills, interest and devotion in the field, communication skills, organizational and presentation skills are to be evaluated. Evaluation of the personal and social qualities also should be done. So the evaluation should be continuous and comprehensive.

Terminal or Term End Evaluation (TE)

It is the written form of evaluation aimed at evaluating the facts, concepts and ideas gained by the learner. The test should not be aimed to evaluate the memory alone. Questions are framed in such a way that the learners are able to apply different mental process while answering. The Terminal Evaluation questions give more emphasis on application, analysis and synthesis level.

The maximum scores for TE is 80 and the minimum is 24 (30%). The questions should be formulated taking into consideration the time required to read, think, understand and write answers. These aspects should be considered while fixing the scores also. To avoid blind guessing, multiple choice and application level questions may be mixed. The total number of questions may vary from time to time. All the questions should be based on the curricular objectives. Open ended questions may be included. Choice questions, if included also should be based on the same curricular objectives.

Continuous and comprehensive evaluation (CCE)

Our traditional evaluation methods measure only the memory and recollection capacity of the learner. To eliminate/ overcome the limitation the evaluation should be done on multi dimensional ways by measuring multiple intellectual capacities of the learner. So it is better to evaluate the learner in a continuous and comprehensive manner. CCE helps the learner to understand and develop his own progress and to develop adequate strategies for further improvement.

Merits

1. Assess the all round development of the learner on a continuous basis through a variety of activities.
2. Effective feed back is possible
3. Remedial diagnostic teaching is possible
4. Process as well as products are assessed.

A series of learning activities are grouped into five major thrust areas as follows

Investigative activities

Activities which create a spirit of enquiry, investigation and a mind for research in the learner belong to this group.

For example.

1. Study project
2. Case study
3. Field study

Interactive activities

Activities which improve the communication skill, activities of sharing ideas, etc.

For example

1. Seminar
2. Panel discussion
3. Debate
4. Group discussion

Assigned task

Activities assigned to the learners to enrich/ strengthen the concept and ideas.

For example

1. Assignment
2. Collections

Performance task (Tests)

Activities related to the achievements of the learner.

For example

1. Class test (oral/ written/ performance test)
2. Quiz
3. Open book examination
4. Interview
5. Group testing

Practical based activities

For example

1. Preparation of working model
2. Album
3. Improvisation

From the above five group of activities, the teacher has the freedom to choose any three areas for evaluation purpose.

1. Investigative activity

Sl.No.	Stages	Criteria	Score	TotalScores
1.	Planning	Planning Relevance of the study Identification of problem Ability to select appropriate tools, ability to select suitable bearing method.	4/3/2/1	
2.	Data collection	Ability to collect sufficient and relevant data. Ability to classify and arrange data for analysis. Reliability and authenticity of the data collected.	4/3/2/1	
3.	Analysis and inference	Ability to analyses the data Systematic arrangements Ability to draw inferences based on analysis. Ability to give suggestions based on inference.	4/3/2/1	
4.	Report Presentation	Ability to present in logical and sequential order, authenticity of report, time bound comparison.	4/3/2/1	
5.	Viva-Voice	Knowledge of content and process. Ability to analyses data. Ability to justify inference. Ability to explain. Strategies and methods adopted.	4/3/2/1	

Case Study

Sl.No	Criteria	Score	TotalScores
1.	Identifying the problem	43/2/1	
2.	Approach to the problem	43/2/1	
3.	Timebound Action	43/2/1	
4.	Analysis of the problem	43/2/1	
5.	Problem solving /Reporting	43/2/1	

Field study

Sl.No	Criteria	Score	TotalScores
1.	Attitude and readiness towards the task	43/2/1	
2.	Capacity for Observation	43/2/1	
3.	Data collection	43/2/1	
4.	Application of ideas	43/2/1	
5.	Documentation/ Recording	43/2/1	

Assignment

Sl.No	Criteria	Score	TotalScores
1.	Awareness of the content	43/2/1	
2.	Comprehensiveness of the content	43/2/1	
3.	Systematic and sequential arrangement	43/2/1	
4.	Observation/suggestion/views/judgment/evaluation	43/2/1	
5.	Timely Submission		

Seminar

Sl.No	Criteria	Score	Total Score
1.	Planning and Organization	43/2/1	
2.	Collection and data / content	43/2/1	
3.	Observation/ appraisal and clarity	43/2/1	
4.	Content knowledge	43/2/1	
5.	Presentation	43/2/1	

Debate

Sl.No	Criteria	Score	Total Score
1.	Readiness to participate	43/2/1	
2.	Depth of subject knowledge	43/2/1	
3.	Communication skill	43/2/1	
4.	Ability to justify the stand	43/2/1	
5.	Presentation	43/2/1	

Group Discussion

Sl.No	Criteria	Score	Total Score
1.	Readiness to participate	43/2/1	
2.	Depth of subject knowledge	43/2/1	
3.	Communication skill	43/2/1	
4.	Ability to justify in a democratic way	43/2/1	
5.	Leadership quality	43/2/1	

Interview

Sl.No	Criteria	Score	Total Score
1.	Planning	43/2/1	
2.	Preparation of Questions	43/2/1	
3.	Communication skill	43/2/1	
4.	Participation	43/2/1	
5.	Report preparation	43/2/1	

Practical Evaluation (PE)

The goal of vocational Education is to generate skills through continuous practices along with investigation and innovations. Continuous and comprehensive practice transforms the unskilled learner to a skilled one. This is the importance and significance of vocational practicals.

PE is done to evaluate the practical skills achieved by the learner in the concerned vocational subject. Total Scores for PE is 150 and minimum is 60 score i.e. 40%. Practical Examination is conducted for a batch of 8 learners having 6 hours duration.

Practical evaluation should be done taking into account the whole practicals included in the curriculum since learning of practical skills is a continuous process through out the period of study.

Vocational Competency Evaluation (VCE)

Vocational Competency Evaluation is to evaluate the vocational skill and aptitude developed by the students during the learning process. This is a system to judiciously evaluate the required value addition and consequent capacity building in the concerned vocational curriculum. The vocational education is aimed at developing interest, skills and devotion in specific vocational fields. As other evaluation components like CE, PE and TE cannot assess the vocational competencies and professional skills, acquired by the students an internship evaluation (IE) components has been introduced to meet this requirement.

Internship evaluation should be done based on the following components like regularity and punctuality, value addition and capacity building.

1. Regularity and punctuality

Regularity and punctuality has vital role in vocational education learning continuous process, the regular presence of the learner is must for attaining maximum efficiency.

2. Value Addition

Value addition is the qualitative measure of the learner's interest, devotion perseverance and efficiency. Value addition can be evaluated through conducting field visits/ vocational survey. The experiences gained through field visit / vocational survey increases the level of intrinsic motivation and positive attitude towards the vocational field and thereby increase his value as a semiprofessional.

3. Capacity Building

It gives a quantitative measure of the student's skill in graded area exposure. Capacity building can be evaluated through conducting the following activities.

1. OJT / Simulated experiment
2. Performance – camp/exhibition/clinic
3. Performance – PCT/Service cum Training center.

These components help the learner to practise the acquired skills in the real situation and thereby increasing self-confidence and promoting self reliance.

Vocational Competency Evaluation Indicators

No	Items	Scores
1.	Regularity and punctuality	10
2.	Field visit / survey (anyone) vocational project	20
3.	OJT / simulated experiment performance – Camp/exhibition/clinic Performance – PSCTC (anyone)/Practical skills	20
	Total	50

1. Regularity and punctuality can be assessed by using attendance of the learner and time bound completion of tasks. It is evaluated by using 5 point grading system.

Rating scale

Sl.No.	Item	1	2	3	4	5
1.	Regularity	Never regular	After regular	Equally regular	Most of the time regular	Always
2.	Punctuality	Never regular	Often punctual	Usually punctual	Most of the time punctual	Always punctual

Item	Evaluation indicators	Scores	Score
Value addition	<i>Field visit</i>		
	1. Attitude and readiness towards the task	4/3/2/1	
	2. Capacity for observation	4/3/2/1	
	3. Data collection	4/3/2/1	
	4. Application of ideas	4/3/2/1	
	5. Documentation/recording	4/3/2/1	
	<i>Or</i>		
	<i>Survey</i>		
	1. Planning	4/3/2/1	
	2. Data collection	4/3/2/1	
Capacity Building	<i>OJT/Simulated experiment</i>		
	1. Involvement/participation	4/3/2/1	
	2. Skills in doing work/communications skills	4/3/2/1	
	3. Time bound action	4/3/2/1	
	4. Capacity for observation, analysis and innovation	4/3/2/1	
	5. Documentation, recording and display	4/3/2/1	
	<i>Or</i>		
	<i>Performance in camp/exhibition/clinic</i>		
	1. Ability for planning and organizing	4/3/2/1	
	2. Mastery of subject	4/3/2/1	
	3. Ability for communication	4/3/2/1	
	4. Innovation	4/3/2/1	
	5. Involvement/social commitment	4/3/2/1	
	<i>Or</i>		

	<i>Performance in production/service cum training center (PSCTC)</i>		
1.	Mastery of vocational skills	4/3/2/1	
2.	Managerial capacity	4/3/2/1	
3.	Promoting self confidence	4/3/2/1	
4.	Innovation approach	4/3/2/1	
5.	Promoting self reliance	4/3/2/1	

CRITERIA FOR PROMOTION

A minimum of 80% attendance is required to register for the public examination. Those who are having at least 65% can apply for condonation from higher authorities. Those who have shortage of attendance below 65% should repeat the second year.

The students should obtain minimum 30% score in all subjects separately in TE. In first year if the student failed to obtain 30% minimum score in any subject he will be promoted and will be given chance for improvement.

The students should obtain a minimum of 40% score in the vocational practical Evaluation (PE) that is 60 out 150 score. If a student fails to attain the minimum required score for TE and secure minimum score for pass in TE, he need not reappear for practical examination and vice versa.

UNIT WISE ANALYSIS

UNIT-1

BRACKISH WATER FISH/ SHELL FISH CULTURE

INTRODUCTION

Brackish water aquaculture appears to have developed in India, Indonesia, Philippines and in some other south east Asian countries as an interim phase of resource utilization. India is endowed with vast areas of traditional brackish water aquaculture systems. However the production from these systems are very low ,mainly because these systems depend on natural stocking of seeds of shrimps and fishes by tides. Our country is bestowed with plenty of brackish water resources which can be developed into brackish water aquaculture system. Concerted effects are under way to develop these resources in several states. Among the states Kerala is one of the state which have vast areas of traditional brackish water systems. In brackish water aquaculture more thrust has been given to shrimp farming due to its export market as well as high demand in internal market. Now this industry has been facing hardship due to hard hit diseases as well as environmental problems which led to the ban of semi-intensive and intensive shrimp farm in India.

Brackish water occurs near to the sea as a transition zone between fresh water and sea water.Salient features of brackish water area is its ever changing salinity, temperature and other physico- chemical qualities. Organisms that live there are adapted to withstand wide fluctuation in physico- chemical factors. Brackish water areas has been considered as most fertile aquatic region. This chapter aim in familiarizing the complex ecology of brackish water environment.

UNIT AT A GLANCE

CO	Content Area	Activity/ Experience	Materials	Product	Evaluation	Ref
1. To familiarize with brackish water, ecology of brackish water pond through discussion.	Brackish water formation, its sources and advantages as medium for aquaculture.	Discussion	chart	Notes	Participation in discussion	
2. To create an awareness of the soil characteristics of brackish water bodies through discussion.	Water retentive capacity of soil, nutrients in soil	Discussion	Reference books	Notes	Participation	
3. To identify the flora, fauna and plant-animal complex of brackish water bodies through collection and observation.	Comparison of flora and fauna of the fresh and brackish water, lab-lab	Collection and Identification	Plankton net, microscope chart	Identification skill, Notes	participation	

ACTIVITY 1

DISCUSSION ON ECOLOGY OF BRACKISH WATER

Make a discussion on the formation of brackish water, different sources of brackish water and advantages of brackish water as a medium for aquaculture compared to other medium. Discussion points are:

- Brackish water formation
- Different sources of brackish water
- Salinity fluctuation in brackish water
- Fluctuation in other physico-chemical factors
- Advantages of brackish water (unlimited water supply, rich supply of nutrients, buffer system in brackish water, antiseptic effect of brackish water etc)
- Euryhaline organisms and stenohaline organisms

- Eurythermal organisms and stenothermal organisms
- .

Consolidate the points and prepare notes.

ACTIVITY 2

DISCUSSION ON THE NATURE OF BRACKISH WATER SOIL

Arrange a discussion on the nature of brackish water soil.

Discussion points:

- Water retentive capacity of soil –jelly like consistency of bottom soil
- Components of bottom soil
- Nutrients in bottom soil
- Sedimentation in brackish water pond.

Consolidate the points and prepare notes.

ACTIVITY 3

COLLECTION AND IDENTIFICATION OF FLORA AND FAUNA OF BRACKISH WATER POND

Students are divided into groups and ask each group to select different brackish water area. Plankton samples are collected from different locations using plankton collection net. Collect bottom samples to analyse benthic algae, benthic animals and plant- animal complex found in brackish water pond. Samples are brought to laboratory and they are observed through microscope . Identify the organisms found in brackish water area with the help of chart/ text book. Prepare chart showing different phytoplankton(flora) and zooplankton(fauna) found in brackish water pond. Direct the learners to submit chart and tell them to draw it in the practical records. Make a discussion on the above activity

Discussion points are

- Phytoplankton and benthic algae
- Zooplankton and benthic animals
- Plant-animal complex found in brackish water ponds
- Comparison of flora and fauna of brackish water and fresh water

Consolidate the discussion and prepare notes.

UNIT 2

SELECTION OF SITE FOR CONSTRUCTION OF BRACKISH WATERFARM

INTRODUCTION:

Site selection is the first step involved in the brackish water aquaculture. Successful management as well as economic viability of brackish water farm greatly depend on its construction at a suitable site. There are two kinds of brackish water farm based on the way in which they receive water. Tide fed and pump fed. Tide fed farm are usually traditional farm which is considered as more economic way of water management. There is natural exchange of water through tides and tide brings in a lot of nutrients and seeds of fishes and shrimps. Pump fed farms are usually modern farm which have better control of water management and undesirable organisms entering the pond. Suitable site for brackish water farm are located in different types of coastal areas such as tidal mud flats, estuarine marshes, mangrove swamps etc. The basic criteria for selection of site for construction of brackish water farm are (i) Topography (ii) Tidal amplitude (iii) source and quality of water (iv) soil characteristics (v) Accessibility (vi) socio economic aspects.

UNIT AT A GLANCE

CO	Content/ area	Activity / experience	Materials	Product	Evaluation	Ref
1. To collect information on the criteria for the selection of site suitable for constructing brackish water farm through discussion.	Topography, Tidal amplitude, Water source, Water quality parameters, soil characteristics, pollution etc.	Discussion.	Location map.	Datas	Participation, skill in observation.	

2. To develop skill in the identification of site suitable for the construction of brackish water farm through field survey and field study.	Tidal amplitude, water source, salinity, dissolved oxygen, temperature, pH, Turbidity. Soil texture, composition, pollution in water source	Field survey and field study	Wooden poles, Salino meter DO meter, Thermometer, pH solution, pH meter, secchi disk, soil sample	Datas	Participation, skill in observation	
3. To get an idea about the compilation of data collected by field survey through discussion	Analysis and compilation of data collected through field survey and field study.	Compilation of data.	Datas collected through survey and field study.	Datas, Notes	Involvement	
4. To develop skill in the identification of site suitable for farm construction based on field survey through discussion.	Selection of suitable site based on data collected through survey.	Identification of site	Datas	Notes	Involvement	

ACTIVITY-1

DISCUSSION ON THE CRITERIA FOR THE SELECTION OF SITE FOR BRACKISH WATER FARM CONSTRUCTION

Arrange a discussion on the criteria for the selection of site. Students are divided into groups and give them slip showing various criteria under consideration. Give them sufficient reference materials. Ask the students to go through the reference material make point for discussion. Each criteria is discussed and note down the points. Like this all groups are directed to discuss on the criteria given to them. Teacher may consolidate the discussion points by giving significance of each criteria for the selection of site. Ask all the students to prepare notes after the discussion.

Various criteria under consideration are.

- Topography of the site(Terrain and elevation)
- Tidal amplitude (mention tides)

FINDINGS OF STUDENTS

--

NAME AND SIGNATURE OF SURVEYOR

NAME AND SIGNATURE OF TEACHER IN CHARGE

ACTIVITY 2.1

TOPOGRAPHY OF THE SITE

Ask each group to study the topography of the location assigned to them. Various points to be considered while studying the terrain and elevation of the site are.

- Highly elevated areas and deepest areas are avoided
- Gently sloping towards the source of water
- Ground elevation should be like that risk of overflowing during high tide should be avoided
- Complete draining of the pond should preferably be possible during low tides.

All the students of the group should participate well in survey. A teacher or instructor may accompany the students. If possible a parent from that particular location may also join the students. Enter their findings in the proforma and all the details of surveying must be noted down in the vocational diary.

ACTIVITY 2.2

TIDAL AMPLITUDE AT THE SOURCE OF WATER

Identify the source of brackish water for the site and observe the tidal amplitude of the location. Fix a wooden pole in the water source and mark the level of water in the pole during low tide and high tide. Record the data and continue it for 23days

.The average difference between high tide and low tide is taken as tidal amplitude of that area. Record the findings in proforma and vocational diary.

ACTIVITY 2.3

COLLECTION AND ANALYSIS OF WATER

The water quality parameters at the site should satisfy the requirement of the species to be cultured. If the water do not satisfy the requirement ,such site have to be avoided. Ask all the groups to collect and analyze water quality parameters such as pH, Turbidity, Salinity, Dissolved oxygen etc

ACTIVITY2.3.1

ANALYSIS OF pH

Checking the water pH is among the first step to be conducted while selecting a site. Ask each group to collect water sample and analyse th pH. pH of the water may be checked before day break, continued for a day till sunset at different times. pH can be measured in the site itself using suitable method. The data collec ted is noted in the vocational diary and in proforma. Plot a graph using the data.

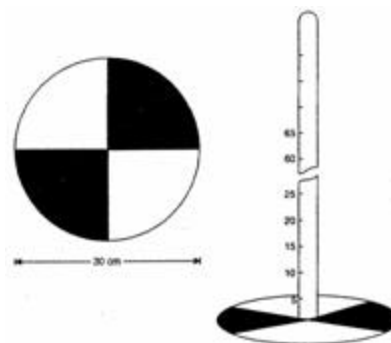
Various point to be kept in mind while analyzing the pH are

- Generally a pH range of 6.5-9 is regarded as most suitable pH
- Diurnal fluctuation of pH -lowest at day break and highest in late afternoon
- pH 4 is acidic death point and pH 11 is alkaline death point.

ACTIVITY 2.3.2

OBSERVATION OF TURBIDITY OF WATER SOURCE

Ask each group to take seechi disc reading of the site under consideration. They can recollect the procedure of the turbidity checking in the first year class. Seechi disc constructed in the first year class can be used for the purpose or construct a new one or can use any other field method. A model of the seechi disc is given.



Immerse the disc into the water. Measure the depth at which the disc disappear first. Then lift the disc and measure the depth at which it appear first. Take the average of these two and take it as seechi disc reading. This experiment may be continued three or four times and take the average of the reading. Record the reading in proforma for the survey and in vocational diary.

Additional informations

- Turbidity caused by the excess suspended solids in the water create respiratory problems in shrimps and fishes by clogging the gills
- Heavy siltation leads to raising the level of pond bed .
- High turbidity restrict light penetration.
- Use settling ponds in highly turbid area.
- Scattering of gypsum over the entire water surface at a rate of 200 Kg/100m³ is effective in removing the turbidity.
- Optimum range of seechi disc reading in water is 25 –45 cms
- If it is less than 25 cm water should be changed
- If it is more than 45 cms fertilise the pond to increase the plankton production

ACTIVITY 2.3.3

ANALYSIS OF THE SALINITY AND ITS VARIATION

Each group are directed to collect water sample for analyzing salinity. Brackish water is characterised by the wide fluctuation in salinity. Salinometer can be used for the salinity determination. Analyse salinity at different times of a day. This can be continued for four to five days. Record the data and study the diurnal variation the salinity. A graph may be plotted for showing salinity variation. Students may also try to collect data regarding seasonal variations in salinity of the site under study from Government agencies. Record the data in the proforma and in vocational diary.

Additional information

- Salinity of brackish water varies from 3.5ppt-36ppt
- Brackish water organisms are euryhaline as they can withstand salinity variations

- Suitable salinity range for fishes and shrimps

NAME OF SPECIES	OPTIMUM RANGE OF SALINITY
CHANOS CANOS	
MUGIL CEPHALUS	
ETROPLUS SURATENSIS	
PENAEUS MONODON	
FENEROPENAEUS INDICUS	

ACTIVITY2.3.4

ANALYSIS OF DISSOLVED OXYGEN

Before going for the analysis of dissolve oxygen students may be given a class on how to collect water sample for the analysis of dissolved oxygen. Various point to be considered are

- Use only clean DO bottle
- Take the water sample without bubbling.
- Close the bottle well
-

Take the water sample in oxygen bottle from various location at different time of a day starting from early morning. Analyse the water sample in the lab using a standard procedure.A suitable procedure may be given by the teacher.For example give the procedure of winkler method.Study the diurnal variation in dissolve oxygen. Study the average dissolved oxygen level. Observe the temperature of the water at the time taking sample and record it.Plot a graph showing variations in the dissolved oxygen.Analyse relationship dissolved oxygen with salinity and temperature and plot a graph showing relationship between these three.

Additional informations

- Dissolved oxygen is at minimum just before day break
- Dissolved oxygen is at maximum late afternoon
- Solubility of dissolve oxygen decrease with increase in temperature and salinity

- Major share of dissolved oxygen is contributed by photosynthesis of plant

ACTIVITY 2.4

ANALYSIS OF SOIL CHARACTERISTICS OF THE SITE

Direct each group to study the soil characteristics such as texture and composition of soil, its water retentive capacity, fertility etc. of site under study. Take soil sample by digging a test pit of 1.5 mtr in length, 0.8mtr in width, and 1.5mtr depth from random locations. Roll some wet soil from the site between palms. If it can be rolled into a rod shape and can be bent into a circle without cracking, it is clayey soil. If it remains separate, it is sand soil. Both these are not suitable for the construction of embankment. Too clayey soil cracks when it dries up and the latter is too porous to retain the water in the pond. A combination of sand and clay is found suitable for the construction of pond. Teacher can give any other suitable field method to analyse the soil than mentioned above. Record the findings in the proforma and in the vocational diary.

Additional informations

- Sandy clayey to clayey loam soil are suitable for the construction of embankment
- Particle size of sand, silt and clay
 - sand - .05-2.0mm
 - silt - .002-.05mm
 - clay - < 0.002mm
- Fertility of the soil can be identified by observing the vegetation
- Acid sulphate soil problems and its remedies

ACTIVITY 2.5

OBSERVATION OF ACCESSIBILITY TO SITE AND SOCIO

ECONOMIC ASPECTS OF LOCATION

Along with the field study learners must study the accessibility of the site and other socio economic aspects of people living in that area. Various points to be considered are

- Proximity to market and processing plant

- Accessibility to market for the purchase of feeds, fertilizers, fish toxicants, nets, farm implements etc.
- Accessibility to hatchery site for the purchase of seeds
- Availability of electric power and telecommunication facility.
- Social and economic condition of local people in the location.
- Widest interest of the local people of area in starting a farm there.
- Availability of cheap labour etc

ACTIVITY 3.

COMBILATION DATA COLLECTED THROUGH SURVEY

Arrange a discussion on the compilation of data collected through survey. Give all necessary instruction to the learners regarding compilation. Make a separate proforma for this purpose.

PROFORMA FOR THE COMPILATION OF DATA COLLECTED DURING SURVEY

NAME OF AREA SURVEYED :
 NAME OF OWNER :
 EXTENT OF AREA :
 LOCATION CHART :

FINDINGS OF STUDENTS

PARAMETERS/CRITERIA UNDER STUDY	DATA OBTAINED	REMARKS
pH		
Turbidity		
Salinity		
Temperature		
Dissolved oxygen		

ACCESSIBILITY AND SOCIO ECONOMIC

ASPECTS OF LOCATION :

STATE WHETHER THE SITE UNDER STUDY IS
SUITABLE OR NOT BASED ON THEIR
FIELD STUDY AND FIELD SURVEY :

Name and signature of the student
charge

Name and signature of the teacher in
charge

Additional information

Table showing optimum water Quality Parameters required for construction of
brackish
water farm

WATER QUALITY PARAMETERE	OPTIMUM RANGE
Salinity	15-30ppt
Dissolved O ₂	4-5ppm
PH	7.5-9
Turbidity	30-50cms
Temperature	28-30 ⁰ C

ACTIVITY 4.

DISCUSSION ON THE SURVEY REPORT

Arrange a discussion on the survey report. Ask the student to submit the report in a time bound manner. It is taken as a tool for the CE. The complete report can be kept in the library. We can give it for reference to Government agencies who promote fish and shrimp farming.

UNIT-3

DESIGN AND CONSTRUCTION OF BRACKISH WATER FARM

INTRODUCTION

The two important pillars of fish farming are the ponds construction and the management practices carried out there in. Essential features of the pond are that it must be manageable for controlled farming. An ideal pond should have different components like dykes, sluiceway, intake point, feeder canals, reservoir ponds, drainage canal, etc. Before starting construction of farm layout farm should be drawn considering the peculiarities of the location like source of water, drainage facilities etc. Design of other component like dykes, position of sluice gates, feeder canals, buildings like laboratories, store watchman's hut etc should be made. For a modern farm, different kinds of pond like nursery pond, rearing ponds, stocking ponds, breeding ponds etc must be constructed. Modern facilities like reservoir ponds, filtration ponds, sedimentation ponds, effluent treatment ponds, etc also should be considered.

UNIT AT A GLANCE

CO	Content/ area	Activity/ experience	Materials	Product	Evaluation	Ref
1. To familiarize with different components of brackish water farm such as dykes, feeder canal etc through discussion and field visit	Dykes, sluiceway, feeder canal, reservoir pond, sedimentation pond, effluent treatment pond, pond depth, slope of bund, rough layout, drainage canal, lab equipment	Field visit observation field visit report,	Rough layout of farm, data of farm structure, diagram of bund showing slope.	Data, layout, diagrams of farm structure.	Participation in discussion and observation skill	

2.To develop an idea about the preparation of selected site for farm construction through discussion.	Preparation of site	Discussion	Reference materials	Notes	Participation in discussion	
3. To develop skill in design and layout preparation through chart/mode	Design and layout	Model preparation	Layout, charts, datas etc. collected from farm, clay, thermo Cole	Model chart	Skill in modeling of farm.	
4.To acquire idea about different steps in the construction of farm through discussion.	Marking of pond area on the contour, Digging ,bund construction	Discussion	Reference materials	Notes	Participation	

ACTIVITY 1

FIELD VISIT TO OBSERVE DIFFERENT COMPONENTS OF BRACKISH WATER FARM

Conduct a field visit to observe the various components of the farm like dyke, sluice gates etc and their function, shape, structure and position. The learners should make a rough lay out of the farm. Note the depth of the ponds, cross-section of bund(note the slope), different types of sluice gates, fixing of sluice gate etc. Prepare field visit report.

ACTIVITY 2

DISCUSSION ON PREPARATION OF SITE FOR FARM CONSTRUCTION

Arrange a discussion on the preparation of site for farm construction.

Point for discussion

- Removal of trees and shrubs from the site
- Clearing of stones, roots etc
- Leveling of site
-

ACTIVITY 3

SKILL DEVELOPEMENT IN THE DESIGHN AND LAY OUT

PREPARATION

Students are divided into groups. Give them instructions regarding how to design a farm. Different design aspects may be given in the class in the form of some reference materials. Different points that have to be considered are

- Percentage of area allocated to different ponds such as nursery pond, rearing pond, production pond etc.
- Shape and area decided for each type of pond and its numbers
- Area required for the bund construction, feeder canals etc
- Area for the provision of laboratory ,watchman shed etc.
-

Give fixed area to each group and ask them to prepare a standard layout with suitable scale. They can refer the layout of the farm they have visited. Use chart paper and colour pencils for drawing the design. Mark the components. It may be exhibited in the class. It can be used as the tool for CE. Using the lay out ask the learners to make a model of a farm using clay or thermocole or even construct sample earthen pond in areas they have sufficient land.

ACTIVITY 4

DISCUSSION ON THE CONSTRUCTION OF FARM

Arrange a discussion on the various steps involved in the construction of farm. Give photos or drawings showing the steps in the construction. Various points to be discussed are

- Marking on the surface
- Digging the pond as per the markings
- Bund construction
- Fixing of sluice gate (mention type of sluice gate)

UNIT. 4

BIONOMICS OF CULTIVABLE FISH/SHELL FISH

INTRODUCTION:

Brackish water environment is characterized by wide variation in physico chemical qualities especially salinity and temperature. Fishes and shell fishes which can tolerate wide fluctuation in these parameter can only grow in brackish water areas. So the study of bionomics potential of species is very important in selection of species for brackish water fish culture .The number of species for brackish water fish culture is very few. This unit deals with criteria for selection of species for brackish water farming and bionomics of cultivable species of brackish water fishes and shrimps.

UNIT AT A GLANCE

CO	Content	Activity / Experience	Materials	Product	Evaluation	Ref
1. To get awareness about the criteria for the selection of species suitable for brackish water aquaculture through discussion.	Species selection giving significance to eury thermal and eury haline species.	Group discussion	Reference	Notes	Participation	
2.To familiarize with bionomics of cultivable brackish water fish and shellfish through assignment.	Bionomics of mullets, milk fish, pearl spot, sea bass, <i>F.indicus</i> , <i>P.monodon</i> , <i>M.dobsoni</i> , <i>M.monoceros</i> , <i>M.affinis</i>	Assignment	Reference materials	Notes	Timely submission	

3.To develop skill in the identification of cultivable brackish water fish and shellfish through collection and observation using charts, specimen and OHP	Identification of fish and shellfish.	Identification	Specimens, chart, OHP	Diagram notes	Identification skill	
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ACTIVITY 1

DISCUSSION ON CRITERIA FOR SELECTION OF SPECIES SUITABLE FOR BRACKISH WATER FISH CULTURE:

Discuss about the criteria for selection of fish/shell fish species for brackish water fish culture. Consolidate the points and prepare notes . Various discussion points are.

- Fast growth rate
- Adaptive feeding to natural and artificial feeds
- Disease resistance
- Eury haline and eurythermal
- Compatibility with other species
- Easy marketability with relatively high demand
- Reliable source of seed must be there
-

ACTIVITY 2

PREPARE ASSIGNMENTS ON THE BIONOMICS OF FISHES/ SHELL FISHES

Divide the students in to groups and ask each group to prepare assignments on the bionomics of the following species

- CHANOS CHANOS
- MUGIL CEPHALUS

- ETROPLUS SURATENSIS
- LATES CALCARIFER
- PENAEUS MONODON
- FENEROPENAEUS INDICUS
- METAPENAEUS MONOCEROS
- METAPENAEUS DOBSONI
- METAPENAEUS AFFINIS

Various aspects that may be covered in the notes of each species are

- Taxonomical classification of species
- Identifying features
- Growth and reproduction
- Food and feeding
- Source of seed
- Water quality parameters suitable for their normal growth

ACTIVITY 3

IDENTIFICATION OF CULTIVABLE SPECIES OF FISH/ SHELLFISH

Identify the specimens of cultivable species of fishes and shell fishes with the help of charts /OHP. Draw the diagrams in records and note the identifying characters.

UN2IT. 5

CONTROLLED BREEDING OF BRACKISH WATER FISHES AND SHELL FISHES

INTRODUCTION:

The breeding requirements of important brackish water fishes suitable for culture are rather complex and the knowledge of the optimum condition for their spawning is still very limited. Most of the brackish water fishes do not breed in confined water. They breed in open sea. The seeds enter in to the estuaries and back waters. They use these water bodies as nurseries for feeding and growth. After attaining particular size, they migrate back to the sea for breeding .To breed them in captivity, some breeding technique must be done. Controlled breeding of mullets and milkfish are successfully done in India. A reliable and sophisticated technology to breed them in captivity on a large scale is till in infant stage. The farmers depends on natural collection of seed. For their requirement this adversely affects the culture of brackish water fishes. Controlled breeding of cultivable species of penaeid prawn is a comparatively recent development .As in the case of brackish water fishes, the prawn also do not breed in captivity. Most of the penaeid prawns attain sexual maturity where darkness, low temperature and high pressure occur which stimulate breeding. With the advent of the technology for the maturations of prawns in captivity, large -scale production of seed is possible. Studies are going on in the induced breeding of molluscs in India and some other countries. This unit deals with the controlled breeding of fishes and shellfishes in brackish water.

UNIT AT AGLANCE

CO	Content area	Activity/ Experience	Materials	Product	Evaluation	Ref
1. To get an awareness in induced breeding of fish and shellfish through assignment	Induced breeding of Grey mullet, milkfish, penaeid prawns and molluscs.	Discussion assignment.	Reference materials	Notes	Participation, timely submission	

2. To create an awareness about the induced maturation of shrimp(eye-stalk ablation) through discussion.	Induced breeding of shrimps.	Discussion	Reference material	Notes	Participation	
3. To develop a skill in eye stalk ablation process through practical work	Eyestalk ablation process in locally available shrimp (live/dead).	Ablation of eye stalk	Shrimps, scissors, electrocauter y apparatus, burner, thread, blade etc	Skill development	Participation	

ACTIVITY 1

PREPARE ASSIGNMENTS ON INDUCED BREEDING OF BRACKISH WATER FISHES/SHELL FISHES

Students are divided in to groups and lead each group to prepare assignment in induced breeding of mullets, milkfish, penaeid prawns and commercially important molluscs. Provide reading material and guidance. After submission of assignments, conduct discussion. Different topics for assignments are:

- Induced breeding of mullets
- Induced breeding of milk fish
- Induced breeding of molluscs

ACTIVITY 2

DISCUSSION ON THE INDUCED MATURATION OF SHRIMPS IN CAPTIVITY

Arrange a discussion on the techniques of induced maturation of shrimps(eye-stalk ablation) in captivity. Various points for discussion are.

- Significance of 'X' organ sinus gland complex found in eye-stalk
- Ovarian maturation inhibiting hormone

- Unilateral eye-stalk ablation.
- Different methods of eye -stalk ablation
- Duration taken for ovarian maturation after eye -stalk ablation
- Size of the shrimps to be used as brood stock.

ACTIVITY 2

SKILL DEVELOPMENT IN EYE-STALK ABLATION

Collect prawns having weight around 15gms. Ask each group to practice the process of eye stalk ablation by different method like

- Cutting of the eyestalk along with eyestalk along with eyeball using surgical scissors.
- Making an incision across the eyeball and squeeze out the contents.
- Teing the eye stalk at the base with thread
- Using electrocautary apparatus.

UNIT. 6

HATCHERY MANAGEMENT

INTRODUCTION

Availability of quality shrimp seeds at proper time and in required numbers is the pre-requisite of successful shrimp farming. Till recently shrimp farming mainly depend on natural collection of seeds for bulk of its requirement. Natural collection of shrimp seed has its own problems. The main draw-backs are (i) catch from nature is un predictable. (ii) undesirable species are also come along with desirable species. With the advent of controlled breeding of shrimps in captivity these problems could be solved to some extent. The successful spawning and larval rearing of shrimps under controlled conditions achieved by Fujinaga in 1942 has paved the way for commercial seed production of shrimps all over the world. Effective seed production in hatcheries necessitate a thorough under standing of the special husbandry and nutritional requirements of the brood stock, larval and post larval stages.

UNIT AT A GLANCE

C O	Content/ area	Activity/ Experimen t.	Materials	Product	Evaluation	Ref
1. To familiarize with the life cycle of penaeid prawn through discussion with the help of chart.	Breeding cycle of penaeid prawn, different larval stages, its duration	Discussion	Chart	Notes, diagrams	Participation	
2. To aquire knowledge in the criteria for the selection of site through discussion.	Sea water supply source of brood stock, fresh water supply, Accessibility.	Discussion	Lay – out	Notes	Participation	
3. To observe different facilities required for a hatchery complex through visit/ Film show and interview.	Maturation section, spawning section, Hatching section, larval rearing section, post larval section , Algal culture , Artemia culture.	Field visit/Film show and interview.	CD, TV	Lay-out	Participation	

4. To develop skill in live food culture through practical studies	Culture of algae, Artemia culture, its harvesting methods. Commonly used diatoms, growth curve of algae	Practical work	Cement tanks, sea water, Artemia cyst, FRP tanks lighting arrangements, aeration facilities.	Skill development	Participation	
5. To familiarize with the selection of spawner through discussion using chart.	Stages of ovarian maturation, health condition of shrimp etc.	Discussion	Chart	Notes, Diagram	Participation	
6. To develop skill in larval and post-larval rearing through practical studies.	Morphology of different larval stages, feeding habits, stocking density, water quality maintenance, Diseases in larva and post larvae, Identification of healthy seed, water intake and storage, Aeration, Laboratory, facilities.	Practical work.	Cystersn , nauplius, sea water, aeration facilities, feeds	Skill development	Participation	
7. To develop skill in the hatchery management through OJT.	Management of maturation section, spawning section, Hatching section, Larval & post larval rearing, Algal culture, water quality, Disease control, sampling, harvesting and packing.	Skill development	Hatchery	Skill in hatchery operation	Participation	

ACTIVITY 1

DISCUSSION ON LIFE CYCLE OF PENAEID SHRIMP USING CHART.

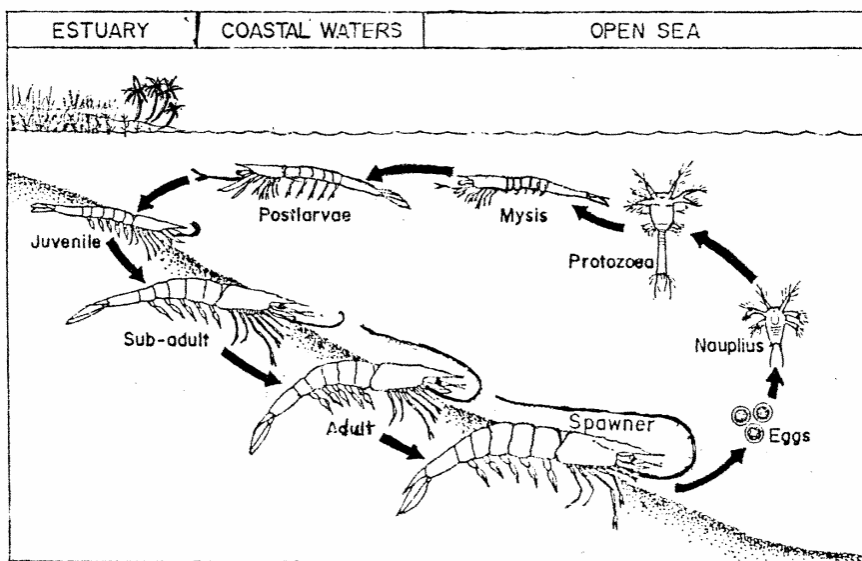
Make a discussion on the life cycle of commercially important shrimps like Tiger prawn or Naran. Standard chart available in M P E D A or prepared chart by student

can also be used for the discussion. Some reference material may also be distributed among the students. Teacher shall consolidate points and ask them to prepare notes and drawings showing different stages of shrimp passing through different ecological zones.

Points for Discussion

- Breeding cycle of shrimp
- Different ecological zones through which they complete life cycle
- Different larval stages.
- Duration of each stages
- Significance of Migration of shrimps
- Shrimp that complete life cycle in the sea itself.
- Identifying features of Nauplius, Zoea, Mysis and PL.
- Food and feeding of larval stages zoea (filter feeding on diatoms) mysis(pickup feeding on zoo plantation)
- Mention how to distinguish male and female shrimps.
-

Chart showing life cycle of *PENAEUS MONODON*



Additional. Information

Impact of stake net, Chinese net on shrimp stock

ACTIVITY 2

DISCUSSION ON SHRIMP HATCHERY AND CRITERIA FOR THE SELECTION OF SITE FOR SHRIMP HATCHERY

Arrange a general discussion on the importance of shrimp hatchery. Students can recollect information on fish hatchery and compare these two. Using reference data student can analyse the major changes in farming sector after commercialization of hatchery production of shrimps. Ask the students to collect data on total number of shrimp hatcheries in India and their production capacity. Prepare a table showing hatchery seed production of shrimps in India for the last 5 years and list major shrimp hatcheries in Kerala. Show separately Hatcheries under Govt. sector and Pvt. Sector.

Total shrimp seed production in India / YEAR	2001	2002	2003	2004	2005

Discussion on the criteria for the selection of site for shrimp Hatchery

Learners are divided into groups and ask each group to discuss on various criteria for the selection of site. Give them slip showing different criteria. Teacher can consolidate the discussion and all the students to prepare notes. Sufficient reference materials may be given if necessary.

Points for discussion

- **Sea water supply**

Parameters	Optimum range
Salinity	30-36ppt
Temperature	27-30 ⁰ C
pH	7.5-8.5
Unionized Ammonia	<0.1ppm
Dissolved O ₂	>5ppm

- Source of Brood stock – Nearness to Hatchery
- Fresh water supply
- Accessibility
- Availability of electric power.

ACTIVITY 3

HATCHERY VISIT TO OBSERVE VARIOUS FACILITIES REQUIRED FOR HATCHERY.

Arrange a field visit to nearby shrimp hatchery. Allocate time to learner for interviewing the Manger of the hatchery. Teacher may notice skill of learners to interview and ability to collect information through that. Learner should go through all the facilities of hatchery and make drawings. Collect details of capacity of tanks and material used for the construction. Draw a sample layout of the hatchery visited and consult manger for correction. Make a discussion on the field visit and check the field visit diary of all students. Teacher can consolidate the discussion points and ask them to prepare notes.

Points for discussion

- Maturation tanks
- Spawning tanks
- Hatching tanks
- Larval rearing tanks
- Post larval rearing tanks
- Algal culturing tanks
- Artemia hatching tanks
- Water intake system
- Water treatment system.
- Aeration system
- Laboratory
- Other facilities

A film show can also be arranged on the operation of shrimp hatchery.

ACTIVITY 4

SKILL DEVELOPMENT IN LIVE FOOD CULTURE FOR FEEDING

LARVAE

Pupil should get sufficient skill in Live food culturing like algal culturing and artemia culturing so that they can use these live food at various stages of larval rearing. Phytoplankton in the form of Diatoms must be ready once nauplius changes to zoea stage and some animal food in the form of artemia nauplis must be ready once zoea metamorphose to mysis stage.

ALGAL CULTURE

Student can practice Mixed culture / mass culture in laboratory. They are divided into groups. Give cement cistern to each group. Ask the students to give transparent roofing to area where cisterns are constructed. This is to prevent dilution of culture medium with rain water at the same time allowing the light to pass through. Cysterns are cleaned well and filled with sea water with optimum quality parameters. Aerate well and Mix the chemical fertilizers to promote the growth of phyto plankton.

Chemical fertilizers	Quantity per tone
Sodium nitrate	25gm
Orthophosphate	2.5gm
EDTA	3gm
Ferric chloride	1.5gm
Urea	10gm
Sodium silicate	10ml

Observe the tank after two/three days for plankton growth. Collect the sample using plankton collection net and observe under microscope. Identify the diatoms dominating using chart. Record the findings in the vocational diary. Ask all the group to submit their findings and make a discussion on it.

Points for discussion

- Pure culture of Algae
- Commonly used diatoms such as Skeleetonema, Tetraselmis and chaetoceros
- Growth curve of algae
-

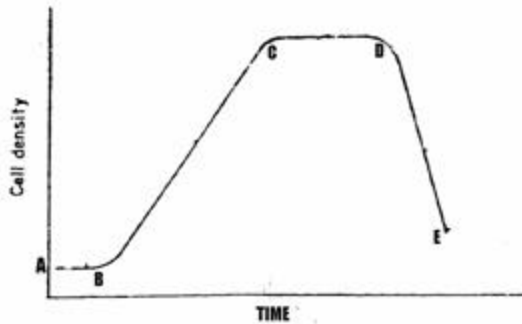
AB – lag phase

BC- Exponential phase

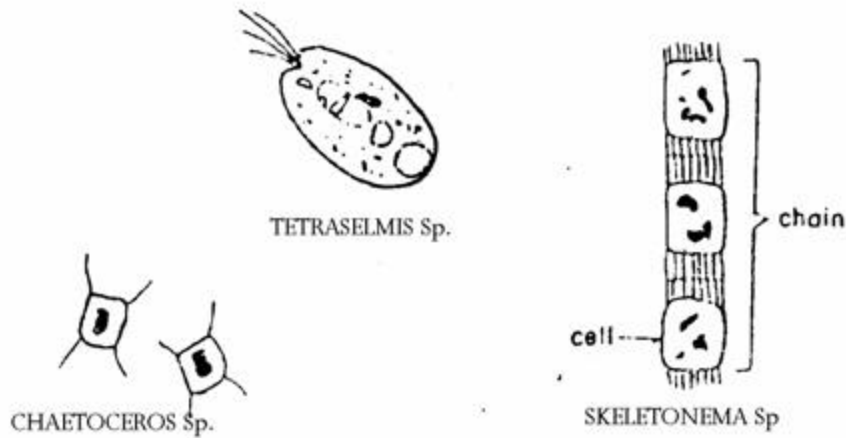
CD- Stationary phase

DE-Declining phase

C- Desk density



Commonly used diatoms in hatchery



Artemia culture

Artemia nauplii is a protein rich live food given to larvae at mysis stage onwards. Artemia cyst available in market. Small fiber glass tanks are used for hatching Artemia cyst.

Students are divided into groups and give tank to each group. Required quantity of artemia cyst for each tank is weighed and hydrate in fresh water. Stock the hydrated cysts and aerate well. After 18-24 hrs. Artemia nauplii will hatch out.

GROUP NO.	QUANTITY OF CYST STOCKED (gm)	TIME TAKEN FOR HATCHING IN HOURS
First Group		

Each group must note down the various steps in activity and their findings in Vocational diary.

Harvesting.

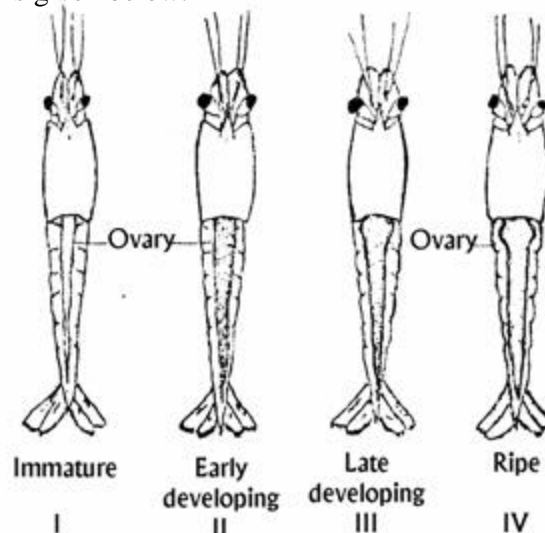
Artemia nanplii are + positively photo tactic in nature. Close the tank with a dark cloth or plastic cover and place a light. The Artemia nanplii attracted forwards the light source and congregated there. They are then siphon out into a bucket and can use for feeding larvae and post larvae. Teacher should ensure that all the students in each group are participating and they are noting in vocational diary. Teacher may help is tabulation of data. Arrange a discussion and consolidate information collected. Ask them to prepare notes on the basis of findings.

ACTIVITY 5

DISCUSSION ON THE SELECTION OF SPAWNER USING CHART

Nauplius to be reared postlarval stage can come either from (a) brood stock(wild or pond reared immature female induced to mature by eye-stalk ablation) (b) Wild spawner (Female shrimps caught from the sea with developed ovary)

Arrange a discussion on the selection of spawner for getting nauplius. Distribute chart showing stages of ovarian maturation in shrimps. Stage of ovarian maturation is not only the sole basis for selection. A chart showing stage of ovarian maturation is given below.



Discussion points

- Spawner at either third or fourth stage of ovarian maturation is selected.
- Reject those with soft shell or injured shell or dull red colour.
- Colour of the ovary is olive green. Reject those with white ovary
- Choose females with bulged thelycum carrying deposited sperm(indicated by white translucent colour.
- Reject the spawner with cut or missing legs or cut rostrum.
-

ACTIVITY 6

SKILL DEVELOPMENT IN LARVAL AND POST LARVAL REARING

Students have already learned various facilities needed for shrimp hatchery and development skill in live food culture through previous activities. They can develop skill in larval rearing and post-larval rearing by using laboratory facilities. Aquarium tanks or fiberglass indore tanks can be used as containers for rearing larvae and post larvae. Pupils are divided into groups and give Aquarium tanks or fiberglass tanks to each group. Electrically operated areators are used for aeration. Containers are cleaned well and filled with fresh and filtered seawater. Filter cloth bags can be used for filtering the water. Nauplii collected from nearby hatchery can be used for stocking in the larval tanks. Nauplii are stocked in the tank as per standard stocking density and note down it. Aerate well

Volume of tank (fiber)	Tank No.	Group No.	Date of stocking	Stocking density	Total No. stocked

Observe the tank daily and examine the metamorphosis of large. Observe larval stages under microscope and confirm the stages using chart and diagram noted earlier in this unit. Generally nauplius changes to zoea within 2-3 days and zoea changes to mysis withing 3-4 days, and mysis changes to post larvae withing 3-4 days. Note down the duration taken for changes from nanpilus to zoea and zoea to mysis and mysis to post larvae in the laboratory.

Group No.	Stocking density of nauplius	Total quantity of Nauplies stocked	Number of days taken for metamorphosis			Survival
			N-Z	Z-M	M-PL	% of PL

Food and feeding

At nauplius stage mouth is not developed. They won't feed. They subsist on Yolk. When they reach zoeal stage, they get the feeding capacity (filter feeding) and feeds on phytoplankton especially diatoms. At this stage culture of diatoms should be ready. When zoea changes to mysis stage feeding habits changes from filter feeding habit to pick-up feeding. Some animal protein must be there in feed. Artemia nauplii are given as food at this stage.

Pupil have developed skill in culture of live food in the earlier activities. Culture of live food should be synchronized with larval rearing so that algal food and artemia will be ready at the time of zoeal and mysis stage respectively. Larvae are planktonic but post larval stage settle down. Post larvae are reared till they reach PL15 –20 stage. Record their findings date wise in the vocational diary. Teacher must check vocational diary. Discuss Larval and post larval rearing in the class daily. Ask the pupils to prepare notes on the basis of practical studies and discussion.

Discussion Points

- Water quality maintenance
- Stocking density
- Feeding
- Diseases in larval and PL
- Identification of Healthy seed.

Additional Information

Prophylictic measure, PCR Test etc.

ACTIVITY 7

DISCUSSION ON THE HARVESTING AND PACKING OF POSTLARVAE

Arrange a discussion on the harvesting and packing of post larvae for sale.

Points for discussion.

- Methods of harvesting
- Handling of harvested stock
- Methods of packing.
-

ACTIVITY.8

SKILL DEVELOPMENT IN HATCHERY MANAGEMENT THROUGH ON THE JOB TRAINING

Management of shrimp hereby can be included in the OJT. Teacher shall arrange OJT for learners in the nearby hatchery. Learner can develop skill in the over all management of shrimp hatchery especially , maturation, spawning, larval and post larval rearing etc. through OIT. Ask the learner to submit OJT Report in time and Arrange a discussion on it.

Points for Discussion

- Maturation of shrimp
- Spawning of shrimp
- Hatching
- Larval and post larval rearinging
- Water Quality Management
- Disease Management
- Feeding in different sections
- Harvesting and packing of seeds
- Algal culture (Indoor and outdoor)
- Artemia culture
-

UNIT. 7

CULTURE SYSTEMS

INTRODUCTION

Different types of culture systems are practiced in brackish water fish and shrimp farming. Of this traditional brackish water is the most primitive and in vogue in different parts of the world. In India traditional brackish water fish and shrimp farming which are known as Bhasabhada fisheries in West Bengal and Prawn filtration in Kerala have been practiced during the last few centuries. The skilled farming in these areas have developed the technique for exploiting naturally available fish and shrimp seed. Advanced pond culture systems include polyculture of fishes and shrimp, composite culture of fishes and shrimps and monoculture of fishes and Prawn etc. Molluscs like oysters, mussels, clams and seaweeds are also cultured in different systems.

UNIT AT A GLANCE

C O	Content/ area	Activity/ Experiment.	Materials	Product	Evaluation	Ref
1.To acquaint with the different culture techniques of mollusks and seaweeds through film show and discussion	Culture techniques of clams, oysters, mussels and seaweeds.	Film show discussion	CD,TV, Reference books	Notes	Participation, keen observation	
2.To develop skill in the collection and identification of cultivable mollusks and seaweeds through practical studies	Identification of Clams, Oysters, Mussels and sea weeds	Collection and identification	Specimens, chart	Notes, Diagrams	Involvement	

ACTIVITY 1

FIELD VISIT AND DISCUSSION ON TRADITIONAL BRACKISH WATER CULTURE SYSTEM, ITS MERITS AND DEMERITS

Conduct a field visit to traditional brackish water farming area. After visit discuss its operation and merit and demerits. Prepare notes. Ask them to submit report.

Discussion Points

- Preparation of paddy field for prawn filtration
- Operation of prawn filtration.
- Time of harvest and harvesting operations
-

ACTIVITY.2

DISCUSSION ON CULTURE SYSTEMS

Give sufficient reading material and ask them to prepare points for discussion.
Arrange a discussion on different culture system .1

Points for Discussion:

- Mono culture
- Poly culture
- Composite culture
- Pen culture
- Cage culture
-

ACTIVITY 3

FILM SHOW AND DISCUSSION ON CULTURE OF MOLLUSCS AND SEAWEEDS

Arrange a film show to see various culture techniques of molluscs and seaweed. Give them study material to refer and make drawings of culture technique based on the film show and reference through study materials about the culture technique of molluscs and seaweed arrange a general discussions.

Points for Discussion

- On bottom culture
- Off bottom culture
- Raft culture
- Rack culture
- Bouchet culture
- Lorytom culture
-

ACTIVITY 4

COLLECTION AND IDENTIFICATION OF CULTIVABLE MOLLUSCS AND SEAWEEDS

Ask the learners to collect different species of molluscs and seaweeds and identify them with chart ,FAO sheet ,reference books are preserved specimens After identification preserve the collected specimen make drawing and write identifying which is feature in the practical record.

UNIT. 8

MANAGEMENT OF FARMS

INTRODUCTION

The success of fish and shrimp farming is mainly depends on the proper management. Yield or production from unit area is maximized through various measures adopted during the growth phase of the cultured organisms. The growth rate, survival and production of a cultured species is influenced by the effort taken during different stages in pond management. In brackish water farm various steps in management can be classified as a) Pond preparation b) Liming c) Fertilization d) Stocking of seeds and its care) Water management.

UNIT AT A GLANCE

C O	Content area	Activity/ Experiment	Materials	Product	Evaluation	Ref
1.To get an awareness on classification of brackish water farm through discussion.	Extensive, Semi-intensive and intensive system of farming	Discussion	Reference	Note	Participation	
2.To acquire knowledge in pond preparation through discussion	Draining of pond, Drying of pond bottom, desiltation etc.	Discussion	Reference	Notes	Participation	
3.To develop skill in the eradication of predatory and weed fishes through practical studies	Use of toxicants its dosage and mode of action	Practical studies	Cement cisterns, live weed or predatory fishes, plant or chemical toxicants	Skill development, notes	Participation, observation skill	
4.To develop skill in the liming of pond through practical studies.	Functions of liming, different forms of lime, dosage, mode of application etc.	Practical studies	Cement cisterns, lime	Skill development, notes	Participation, Observation skill	

5.To develop skill in the pond fertilization through practical studies.	Inorganic and organic fertilizers, its dosages, purpose of fertilization.	Practical studies	Cement cisterns, fertilisers	Skill development, notes	Participation, Observation skill	
6.To develop skill in the seed stocking through practical studies.	Acclimatization, time of stocking, stocking density etc.	Practical studies	Cement cisterns, seed	Skill development notes	Participation, Observation skill	

ACTIVITY. 1.

DISCUSSION ON CLASSIFICATION OF BRACKISH WATER FARM BASED ON THE LEVEL OF MANAGEMENT

Discuss the classification of brackish water farm according to the level of management. Sufficient reference material may be given in the class.

Discussion points

- Extensive farming
- Intensive farming
- Semi-intensive farming
- Comparative study of above three based on the table given below

EXTENSIVE	SEMI-INTENSIVE	INTENSIVE
Low lying coastal areas, paddy fields	Ponds	Ponds, tanks, raceways.
No pond preparation No fertilization No supplementary feed	Preparation of pond Fertilization Supplementary feeding	Controlled environment
Auto stocking	Selective stocking density 3-5Nos/m ²	High stocking 30-50 Nos. /m ²
Low cost of production	Moderate cost of production	High cost of production
Low production 1ton/hr	Medium production >5ton/ha	High production >50ton/ha

ACTIVITY 2

DISCUSSION ON PREPARATION OF POND

Discuss the preparation of the pond in the class. Learner can recollect information about the preparation of fresh water ponds from first year class.

Discussion points

- Draining of pond
- Drying of pond bottom
- Desiltation
-

ACTIVITY 3

SKILL DEVELOPMENT IN ERADICATION OF PREDATORY AND WEED FISHES BY FISH TOXICANTS

Students are divided into group and ask them to collect plant toxicants and chemical toxicant. Different groups use different toxicants. Select cement cisterns with growing stock of weed fishes or tilapia. Then apply toxicants

Group 1-tank No 1-mahua oil cake @ 250ppm

Group 2-tank No 2-Tea seed cake @ 20ppm

Group 3 – tank No. 3

Group 4 – tank No. 4

Ask the students to record tank no, toxicants used ,its dosage. Observe the tank for any mortality of fishes. Note the time interval between application and death of fishes. Discuss the findings in the class.

Points For Discussion

- How the fishes are killed?
- Toxic component of different plant toxicants
- Durations of toxicity
- Various predatory species found in brackish water pond
- List various predatory species in brackish water farm, identify them using chart and specimen.
-

ACTIVITY 4

SKILL DEVELOPMENT IN LIMING OF POND

After the eradication of weed fishes and predatory fishes, examine the pH of water and note down it in the vocational diary. Use the different doses of lime for different pH.

pH	Amount of lime (Kg/ha)
4- 5.5	3000
5.5-6.0	2000
6.0-7.0	1500
7.0-7.5	500

After lime application analyze pH of culture medium. Make sure that pH of the cultured medium become optimum (7.5-8.5). Discuss the liming in the class.

Discussion points

- Functions of lime
- Different forms of lime
- Mode of application of lime
-

ACTIVITY 5

SKILL DEVELOPMENT IN FERTILIZATION

Two week after liming, fertilization is done in the cement cystem. Apply fertilizers at biweekly intervals with organic manure. Observe the water for plantation production.

Different doses of fertilizers

Urea-200Kg/hr/yr

Super phosphate -600kg/hr/yr

Cowding -5000kg/hr/yr

Ask the student to record findings in the vocational diary. Discuss it in the class.

Discussion points:

- Purpose of fertilization
- Inorganic Fertilizers

Organic Fertilizers

- NPK Fertilizers
- Powdered Fertilizers and Liquid fertilizers
- Compare advantages and disadvantages of inorganic and organic fertilizers.
-

ACTIVITY 6

SKILL DEVELOPMENT IN STOCKING OF SEED

After the pond preparation, different species of fishes or shrimps can be stocked in the pond at suitable stocking density. Uniformly sized seed may be used for stocking. Seeds transported from hatchery collected from wild slowly acclimatized to pond water. After stocking discussion may be conducted.

Discussion points:

- Suitable time for stocking
- Stocking density
- Acclimatization
-

UNIT 9

FEEDS AND FEEDING

INTRODUCTION

Fish nutrition is a subject of great importance in brackish water fish and shrimp farming. Nutritional requirements of fishes and shrimps vary with species, stage of growth, temperature, metabolic rate and nature of available food. Growth and activity of fish will depend on the nutrition the fish gets from food. Supplementary feeding is an inevitable part in brackish water farming especially in semi-intensive and intensive farming. Artificial feeds containing sufficient quantity of protein will enhance the production. Deficiency of protein may cause nutritional diseases and other disorders which could adversely affect production. Time of feeding also has great importance. Properly balanced diet with good food conversion ration following the correct feeding schedule only can augment the production. Deficiency of feed will result in poor growth and excess diet will be an economic waste and it may cause pollution also.

UNIT AT A GLANCE

C O	Content/ area	Activity/ Experiment	Materials	Product	Evaluation	Ref
1. To analyse natural fish food organisms in brackish water ponds through practical study	Analyzing phyto plankton and zooplankton found in brackish water	Collection, analyzing Discussion	Plankton net, Microscope, charts	Notes, diagrams	Participation	
2. To familiarize with nutritional requirements of fish through discussion with the help of chart.	Protein requirement, fat requirement of brackish water fish & shell fish .	Discussion	Reading materials	Talk, Chart, Notes	Participation	

3. To develop skill in finding the efficiency of different artificial feeds through project work.	Artificial feeds available in the market, food conversions ratio, efficiency of feed.	Project work	Feeds, Cisterns Fishes	Findings	Participation	
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Activity. 1

Chart preparation of Natural food organisms found in Brackish water Ponds

Learners can use information collected regarding the flora and fauna of brackish water pond in the first unit. Ask them to prepare chart showing the diagram of phytoplankton and zooplankton found in brackish water which form food of fishes and shrimps. Make a discussion on this chart and prepare notes. This chart can be used a tool for CE.

Points for Discussion

- Various Photo plantation found in brackish water
- Various zooplankton found in brackish water
- Lab –lab
-

Activity 2

Discussion on Nutritional Requirement of fishes

Make a discussion on the nutritional requirement of fishes and shrimps. They can recollect information from the first year class (Fish Nutrition). Give sufficient reading material for reference. Ask them to prepare table, chart and notes on the basis of discussion.

Species of fish/Shrimp	Percentage of protein Requirement	Percentage of Fat Requirement	Percentage of CHO Requirement

Discussion points

-
-
-

Activity 3

Project work to find out efficiency of feed in terms of food conversion Ration

Planning : Arrange a general discussion to plan the project Divided students into 4 groups. Discuss the significance of this project and requirements. This project aims at analysing conversion efficiency of a particular artificial feed. Give one cement cistern to each group. Collect commercially important artificial feed available in market.

This can also be collected by contacting the manufactures. Use minimum four types of feed. Note the ingredients of feed from manufacture's note. Give feed to four different groups.

This given cement cisterns are cleaned well and fill it with brackish water with optimum water quality parameters. Stock fishes or shrimp seeds of same size, same age and in same stocking density in all the four tanks. Note down the av. Weight of fish in each tank.

Type of feed	Cement cistern	Stocking Density of shrimp/ Fish	Average Weight	Feeding Schedule
Type 1	No.1			
Type 2	No.2			
Type 3	No.3			
Type 4	No.4			

Start feeding in same schedule in all tanks. Ask the student to prepare table by their own and write down data at each stage of the experiment. Observe the growth rate by checking the weight of fishes at suitable time intervals and continue feeding for 3-4 Weeks.

Cistern No.	Average Initial weight	Av. Wt. After 10 days	Av. Wt. After 5 days	Av. Wt. After 15 days	Av. Wt. After 20 days	Av. Wt. After 25 days	Final Av. Wt. After (-days)
1							
2							
3							
4							

At each stage of experiment water quality parameters are monitored well and if require change the water. Examine the uneaten food , and change the schedule so as to avoid wastage of feed. Note the final average weight one the experiment is completed. Then calculate FCR of each type of feed and note down in the table.

Tank No.	Initial Av. Wt.	Final Av. Wt.	Total quantity of feed used	FCR
1				
2				
3				
4				

Once the experiment is completed, ask the students to submit their findings. Teacher should ensure that every students are participating and recording their findings in the project diary. A general discussion is conducted and direct the students to submit it in the form of project within the declared date. Teacher can use this project as a tool for CE.

Points for Discussion

- F C R
-

UNIT 10

DISEASES AND THEIR CONTROL

INTRODUCTION

Fishes are living in an environment where a lot of disease causing organisms are found. These organisms attack fishes once their self defence is lost under unhealthy conditions. Large scale mortality occurs in pond due to environmental stress, followed by parasitic, bacterial, viral, fungal and protozoan infections. Infestations are more liable to occur in ponds which are heavily stocked. Occurrence and magnitude of infections are closely related to sanitary conditions prevalent in the water as also the general health of the fishes themselves by good pond management. Proper nutrition should be given because a number of nutritionally related diseases are also reported. Once disease outbreak noticed, if proper control is not given will lead to heavy loss due to mass mortality. So knowledge in the disease diagnosis, its prevention and control is essential to manage brackish water fish and shrimp farming.

UNIT AT A GLANCE

C O	Content / area	Activity/ Experiment.	Materials	Product	Evaluation	Ref
1. To observe various diseases and their control through discussion and seminar.	Common symptoms of diseased fish. Common bacterial and viral diseases in brackish water fish and shell fish; their control, common nutritional diseases and its control. Water quality and disease problems.	Discussion Seminar	Reference book Website, journals Magazines.	Notes	Participation	

ACTIVITY 1.

DISCUSSION ON VARIOUS DISEASES, COMMON SYMPTOMS, AND THEIR CONTROL

Arrange a discussion on various diseases and its control. They can recollect information from the first year fish pathology unit.

Points for discussion

Common symptoms of diseased fish

- Loss of balance
- Fish tend to lie on its side either resting at the bottom or floating at the surface
- Tail and fins do not function normally
- Discoloration of body and pale gills
- Slimy secretions on the skin
-
-

Seminar on various diseases and its control in brackish water fish and shrimp

Planning :- Students are divided into six groups. Given them the following seminar topic

1. Common Bacterial and Viral diseases and its control in brackish water fishes
2. Common Bacterial and Viral diseases and its control in shrimps.
3. common fungal diseases and its control in brackish water fishes and shrimps.
4. common protozoan diseases and its control in brackish water fishes and shrimps
5. common Nutritional disease and its control in brackish water fishes and shrimps.
6. Water quality and disease problems in brackish water fishes and shrimps.

Give these topic to each groups. Direct each group to collect information from reference books, websites, magazines, journals. Give them sufficient time for the preparation of seminars. Clear their doubts and ensure participation of all students in the group in the preparation. A representative student or all the members can present the topic. A seminar hall in arranged ask the group leader to invite other faculty members including principal to the seminar. Arrange all the aids including OHP, chart paper marker pen before starting seminar. Rostrum may be arranged if necessary. Give instruction to the other group to note down the seminar point and at the end open for a discussion. Like this all the 6 topics are presented. Teacher can

supplement additional information and all the six papers can be published in the form of a seminar on “Disease and its control in Brackish water fishes and shrimps”. A copy of this can be kept in the library for further reference.

Points for Discussion

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-
-

UNIT. 11

HARVESTING

INTRODUCTION:

Harvesting is one of the tedious jobs in aquaculture operation. In culture fishery, we should make use of market oriented marketing rather than production oriented. The farmer can resort to partial harvesting or complete harvesting or a combination of both. Timely harvesting and profitable marketing of the harvest produce are important factors that govern the economic success of aquaculture enterprises. The crop should be harvested at a size which the market demands and also at a time when the market price is lucrative. While harvesting, the farmer should also keep in mind the cost effective harvesting technique making use of the behaviour of the species and type of culture facility. The farmer should also plan and make arrangements for the produce to be marketed locally or for exporting.

UNIT AT A GLANCE

CO	Content area	Activity / Experiments	Materials	Product	Evaluation	Ref
1. To collect information regarding various aspects to be considered while harvesting through discussion.	Market size of product, market demand, local market or export market, partial harvesting, complete harvesting, cost-effective harvesting, condition of shrimp	Discussion	Reference	Notes	Participation	
2. To observe different steps in harvesting, handling and preservation through film show / Field visit and discussion	Water level maintenance, draining, netting, handpacking, Handling And preservation of fish and shell fish	Field visit/ Film show and discussion	Harvest site CD, TV	Report	Participation	

ACTIVITY 1

COLLECTION OF INFORMATION ON VARIOUS ASPECTS OF HARVESTING

Learners are divided into groups. Each group is assigned to discuss the important aspects to be considered by the farmer while planning the harvest and present it on the blackboard. The teacher may consolidate the discussion by clubbing similar points and provide additional information.

Points for discussion

- Market size of the product.
- Market demand.
- Local market /Export market. Partial.
- Partial harvesting /complete harvesting.
- Behaviour of cultured species and type of culture facility.
- Cost –effective harvesting technique.
- Condition of shrimp
-

ACTIVITY 2

FIELD VISIT/FILM SHOW, OBSERVATION AND DISCUSSION.

A field visit can be arranged to the nearby farm at the time of harvest so as to introduce the learners about various aspects of harvesting. After the visit, a discussion

May be conducted based on the observations made by the learner and ask them to prepare report.

If there is any difficulty in arranging field trip, film show may be conducted. CD's are available from various institutions like Marine products export development Authority (MPEDA), Dept of fisheries etc.

Points for discussion

- Water level maintenance.
- Netting
- Hand picking
- Harvesting through sluice gates
- Handling preservation of the harvested material.

PRACTICAL EVALUATION DETAILING

1.IDENTIFICATION OF SPECIMENS/SPOTTERS:	-	10 X 3 =30 MARKS
2.PRACTICAL WORK		
A) PROCEDURE	-	10 MARKS
B) WORK DONE	-	40 MARKS
C) PERFECTION	-	10 MARKS
3.DIAGNOSIS, SITUATION ANALYSIS AND DEVELOP SOLUTION		
A) PROBLEM IDENTIFICATION	-	10 MARKS
B) ANALYSE	-	10 MARKS
C) REMEDY	-	10 MARKS
4.VIVA VOCE :		20 MARKS
5.RECORDS :		10 MARKS
	TOTAL	150 MARKS

SAMPLE QUESTIONS

1. Complete the sequence

Below 0.5ppt : : Fresh water

_____ : : Brackish water

36ppt : : _____

2. Pick out the odd ones

(Chaetoceros, Moina, Daphnia)

3. Select the brackish water species

(Skeletonema, Chlorella, Volvox, Anabaena)

4. While the routine checking of water quality parameters in a farm, a farmer observed sechi disc reading of 10 cms. He also observed poor growth of fish during sampling. Correlate these two situations. Mention your opinion. Help the farmer by recommending proper remedial measures.

5. Complete the sequence

10-15ppt : _____ : Tiger prawn : 360mm

_____ : *F indicus* : _____ : _____

6. Select the odd one

(Mullet, Catla, Milk fish, Sea bass)

7. Select the odd one based on the breeding habit

(Milk fish, Mullet, Sea bass, Pearl spot)

8. Arrange the following management practices under Extensive farming, Semi intensive farming, and intensive farming.

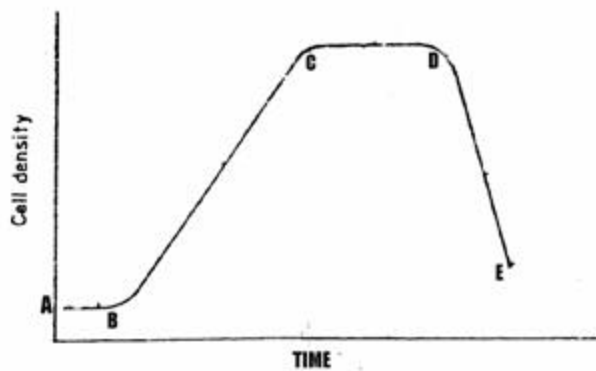
(Prawn filtration, Fertilisation, No pond preparation, Race ways, Auto stocking, Selective stocking, low cost of production, heavy stocking, high cost of production, supplementary feeding, moderate cost of production, high production, low production, medium production)

Extensive	Semi-intensive	Intensive
Prawn filtration	_____	_____
_____	_____	high cost of production
_____	Medium production	_____

9. Arrange the different stages in life history of Penaeid prawn in their order of development

(Mysis, egg, Juveniles, PL, Zoea, Nauplius)

10. Identify different Phase of Growth of Algae from the graph given below.



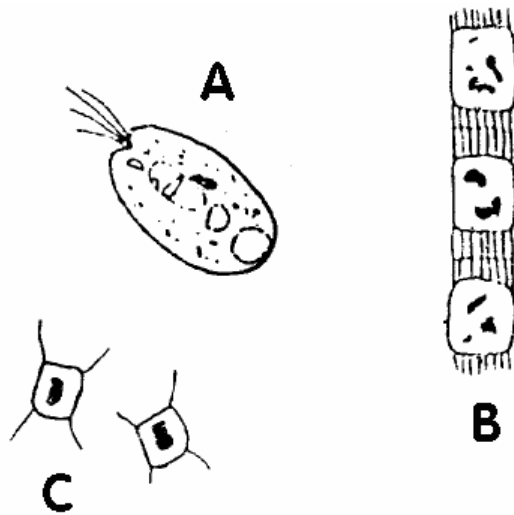
AB =

C =

BC =

11. Suggest remedy measures when you noticed seechi disk reading of 15 centimeters in a fish culture pond.

12. A plankton sample collected from sea water is observed under a microscope. The slide shows the presence of different phytoplanktons. Identify the species.



13. Various diseases in seen in Brackish water fishes and shrimps are given below.

Catagorise them under bacterial, viral, fungal and protozoan diseases.

Ulcer disease, saprolegniasis, hemiclepsis
dropsy, argulus, whirling disease, fin and tail rot, lerneae.

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