Electronics and Instrumentation in Fisheries Sector

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The fisheries sector makes an important contribution to the national economy. It provides food and employment to thousands of rural people, and earns foreign exchange. Successive development plans of the government have emphasized the importance of raising inland and marine fish production, from both capture and culture fisheries. To achieve their goals, governments have (i) encouraged the mechanization and motorization of the fishing fleet; (ii) introduced innovative methods of fishing, and improved infrastructural development; (iii) organized fish transport, storage and marketing.

1. Scope of Instrumentation

Scientific and technological progress depends on reliable and unbiased information, which in turn require advanced instrumentation systems. Subjects becomes more scientific when supported with enough observations, and for which we need measurements. For eg. INCOIS (Indian National Centre for Ocean Information services) under Ministry of earth Sciences, provide ocean data, information and advisory services to society, industry, the government and the scientific community through sustained ocean observations and constant improvements through systematic and focused research in information management and ocean modelling. They provide information's on potential fishing Zone (PFZ), ocean state forecast, tsunami early warnings, storm surge warning, algal bloom *etc*.

The technological interventions help us to reduce the wastage of time, efforts and catches. By implantation of preservation technologies we convert it into value added products with higher shelf life. Use of appropriate technologies along the fish value chain will help in producing better quality products and fetch more markets and higher price. Major areas of technological interventions in the field of fishery engineering cover

- fuel efficient fishing vessels and fiberglass canoes,
- quality improvement of Indian fishing fleet

- design and development of fish processing equipment and machineries,
- energy efficient and eco-friendly solar fish dryers,
- indigenous electronic instruments for application in harvest and post-harvest technology of fish,
- energy and water optimization techniques for fish processing industries.

2. Contribution of CIFT in the form of Instrumentation

ICAR-CIFT identified the vast scope of electronics and instrumentation for fisheries technological investigations and started research and development activities. This resulted in a series of instruments for systematic monitoring, analysis and assessment of the marine environment including the performance of the machineries used for harvesting the resources and post-harvest technology. Basic technologies developed in ICAR-CIFT include different models of solar dryers, fish de-scaling machines, fish meat bone separator and other electronic instruments for fish processing fishing technology, water quality monitoring etc. Instrumentation technology for environmental sciences is highly location specific. Sensors are the important part of any measurement system, especially when operated in open environment. Sensors exposed to the open environment are liable to corrosion and physical damage. Sensors should capable of meeting the operational constraints as they are operated in most hostile environment and sensing the data without being modified and distorted. Sensor design and operational feature must consider the site conditions such as water quality, ambient temperature, humidity, shock and vibration, atmospheric pressure, installation facilities and power availability. In fishing, size of the vessel and nets, nature of the area of operation etc., are important.

2.1 Fish de-scaling machine

Shortage of skilled manpower is a major problem faced by the fish processing industry. Development of a fish de-scaling machine is a step to reduce the drudgery of manual de-scaling of small sized fishes. Mechanization of de-scaling activity can significantly reduce the handling time thereby shortening the pre-processing period. This in turn reduces the overhead costs and also enhances the quality of the final product. CIFT has designed and developed different models and capacities (10 kg, 5 kg and 2 kg) of fish de-scaling machines for removing the scales of fishes in batches. The operation of the machine

can be extended for removal of scales from all types of marine as well as fresh water fishes.

Fig. 1 Different models of Fish de-scaling machines

2.2 Fish meat bone separator

Designed and developed Fish Meat Bone Separator with variable frequency drive to separate pin bones from freshwater fishes. The new system developed can be used at a range of 5-100 rpm. With a unique belt tighten system developed; the new machine can be easily adapted to any species and need not be customised for specimen during design stage. In existing imported models, only two speeds are possible which restricts the yield efficiency in a single span operation and also limits easy switching of the system for utilising specimen other than for which the yield has been originally customised. A commercial version of the unit was fabricated and handed over to Dept. of Fisheries Unit, GADVASU, Ludhiana. One unit is installed in NAAS Complex, New Delhi also.

Fig. 2 Different models of Fish meat bone separator

2.3 Electronic instruments developed in ICAR-CIFT

ICAR- CIFT has designed and developed more than five dozens of electronic instruments with fully indigenous technology and more than 50 sensors with novel features and designs. Some of the instruments developed by CIFT, which attracted great attention and acceptance, are Environmental Data Acquisition System, Freezer Temperature Monitor, Salinity Temperature Depth Meter, Hydro Meteorological Data Acquisition System, Warp Load Meter, Solar Radiation Monitor and Integrator, Ship Borne Data Acquisition System, Water Level Recorder, Ocean Current Meter, Remote Operated Soil Moisture Meter, Water Activity Meter, Rheometer and Micro Algae Concentration Monitor. The instruments are designed to be compatible with computer and solid-state memory module, the information can be stored for long durations and retrieved at our convenience. Instrumentation technology developed in CIFT was found useful and applicable in many related supplementary fields of agriculture and aquaculture. Various universities, research institutions and other agencies involved in R&D activities are using the instruments developed in ICAR-CIFT.

2.4 Navigation light control system

Navigation lights help us and other boaters to determine the give way boat when encountering each other at night. These lights must be displayed from sunset to sunrise and during period of restricted visibility in order to have safety voyage. We have developed a Navigational light control system with alarm facility, which can be fitted in the Wheel house and give full control over the navigation lights. The system displays the status of the exterior navigation lights on an interior mimic panel.

2.5 Freezer temperature monitor

Used for monitoring the temperature of cold storages/freezers/fish blocks with optional facilities for multi-channel, automatic scanning and data storage in memory modules. Sensors with remote operation facility enables centralized monitoring of the data from several points inside, outside and also on the materials

under processing. Sensors with micro size attached with long thin cable enables measurements from inside the fish and fish blocks, during processing. The range of measurement is –40ºC to +40ºC with an accuracy of +/-0.1ºC. The instrument makes an alarm when the temperature deviates from the required range.

2.6 Solar processing monitor

This is a multichannel equipment operates in 9V battery which can be operated manually or automatically for monitoring, Drying parameters relevant to solar drying of fish such as solar radiation, air temperature, relative humidity and air velocity, Estimation of solar and wind energies used during the drying process, Physical changes in the fish during dehydration like weight loss, moisture level and Other environmental changes (water evaporation) and sensors for sensing these parameters. The sensors are selected in a sequential order by a multiplexer attached to the system. The data can be recorded or printed.

Sensors and ranges

Solar radiation	: 0 to 1400 watts/m^2
Wind	: 0 to 50 KMPH
Relative humidity	: up to 100%
Water evaporation	: 0 to 40mm
Weight loss	: 0 to 500gms
Air temperature	: 0 to 80ºC
Fish moisture	: 0 to 80%
Solar radiation integration	: up to 999999 watts/m^2
Wind energy integration	: up to 999999

2.7 Water activity meter

The instrument quickly measures water activity (a_w-value) of food samples kept inside a tight enclosure in the range 0.40 to 0.95 +/- 0.01 and temperature of the environment inside the enclosure in the range 0-

60ºC. Water activity is a measure of free water actually available in food systems to react chemically or in spoilage to support the growth of microorganism such as bacteria or mould. The establishment of water activity as a significant parameter in maintaining storage stability of dry and intermediate moisture food (IMF) has resulted in the need for rapid determination of the value. Analytical methods for finding a_w-value are tedious and time consuming.

2.8 Rheometer

Breaking strength and deformation are two important rheological parameters, which is a measure of the quality index of processed food materials. The instrument was developed for finding the breaking strength of gels (Surimi / Sausages) in the range 0-500gm and deformation of the sample under test in the range 0 – 20mm before the break with facility for recording the data in a strip chart recorder. A motor control is used for raising and lowering a plunger sensor, to compress the sample under test. Every sample piece was prepared to have 25mm height having 5mm diameter is used for compressing the sample. Gel strength is calculated as the product of breaking strength and deformation (g.cm).

2.9 Multi-channel temperature monitor

Designed and developed for simultaneous measurement of temperature from different locations. The equipment consists of 10 nos. sensors and a single meter. Different types of sensors have been introduced with size, shape and features matching to different needs. They are available for measurements from water, cold storages, inside pressure chambers, inside of small objects or surface of hot/cold bodies, leaves and stems of plants, soil, air etc., with different response times down to 3 seconds. They are also available with remote measurement up to a few hundreds of metres for facilitating centralized monitoring.

2.10 Remote operated soil moisture meter

The instrument has got a remote operated moisture sensor and a digital meter, both being connected by long 2-core cable. The sensor senses the presence of moisture without absorbing any part of the moisture.

Uses

1. Estimation of moisture contents in different soils at any depth.
2. Estimation of water preservation properties of different soils at different soils.
3. Estimation of water penetration properties of different soils.
4. Estimation and comparison of water intake needs of different plants.
5. Studies of the soil moisture variations in relation to other variables.

2.11 Ocean current meter

For the measurement of water current and direction of water current using under water probe and an electronic meter on board the vessel, both connected by cable. This instrument has got small, compact and portable under water sensor immersed to the required depth of operation, which produces electrical pulses proportional to the water current and its direction. Both these information conveyed to the onboard meter are displayed digitally. Underwater probe consists of a savanius rotor attached with contact less electro-inductive pick up and facility for automatic stabilization, despite the tilting of the suspension cable, in order to avoid the error due to tilting of the sensor.

- The instrument measures the water current and its direction in sea, rivers and estuaries.
- The instrument is useful for fishery hydrographic, oceanographic, port and harbour and marine environmental studies and routine measurements.
- Survey of fishing grounds for simultaneous acquisition of marine environmental data and its correlation with fish population.

2.12 Fishing log

This instrument is designed for investigations correlating performance of craft, gear, the marine environment and the catch obtained. This instrument is used for monitoring five important parameters pertaining to fishing and related marine environment, with installation on small and medium fishing vessels.

Warp load : 0 to 1000kgs, 0 to 5000kgs, +/-1%

Boat speed : 0 to 15 knots, +/-0.1

Water salinity : 0 to 38PPT, +/-0.1

Water temperature : 0 to 40ºC, +/-0.1

Air temperature : 0 to 50ºC, +/-0.1

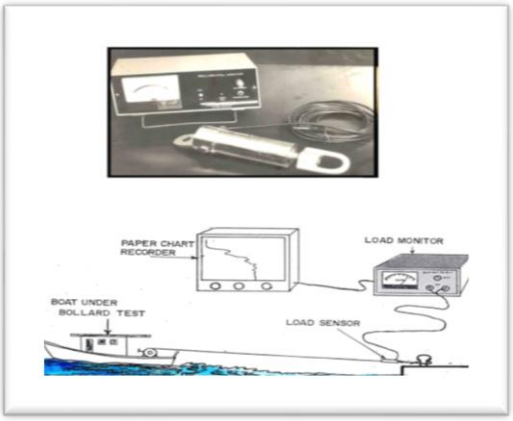
2.13 Speed and distance log

For monitoring the speed of motion of fishing vessels and ships along with the total distance traveled. The instrument consists of an electro-inductive rotor sensor kept immersed in water by means of a side mounting arrangement and an electronic meter for indicating the speed of motion and the total distance traveled in fishing / survey. This is also useful for hydrodynamic studies on the craft and the gear.

2.14 Electronic warp load meter

It monitors the warp load of trawl systems under water and indicates the defective operations of the system This instrument consists of a deflection type load sensor and an electronic display meter.. Two different type have developed 1) portable warp load meter for measurement in small vessels up to 1000kg using clipping type sensor for measurement without disturbing the fishing operation 2) ship installed warp load meter for use in large vessels with permanent installation using the facilities available on the deck.

- The tension transducer can be clipped on the wire rope easily without disturbing the fishing operations.
- Warning alarm can be provided to alert the operator against probable damage / mal-functioning of the net.

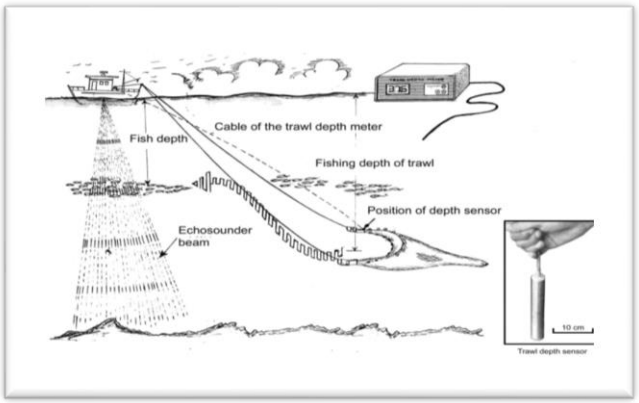


2.15 Bollard pull monitor

For estimating the bollard pull and find out

the suitability of marine engines / boats for different fishing gears / techniques and vice versa. This is used for conducting bollard pull tests of the boats / engines in controlled conditions. The instrument consists of an induction load cell, which converts the tension applied on it into electrical variations, which are conveyed to the indicating meter through two core cables.

2.16 Trawl depth meter



The instrument is used to measure trawl depth during fishing operations and thus to control the net to the depths where fish shoals are located (in echograms) and for monitoring the water depth variations in reservoirs / rivers *etc*. The instrument consists of a pressure sensitive transducer mounted on the trawl net or any underwater object whose depth of operation is to be measured. The electrical signals from the transducer are conveyed to the electronic meter onboard the vessel through a 2-core cable where it is processed and displayed depth in meter.

2.17 Salinity temperature depth meter

This instrument has got an under water probe consisting of a platinum conductivity cell, a temperature sensor and a pressure sensitive transducer for instantaneous measurement of salinity, temperature and depth of the sea respectively. The electrical signals from the transducers are conveyed to the electronic meter on board the vessel where it is processed and displayed as salinity in PPT, temperature in ºC and depth in meters. This instrument is used for environmental measurements leading to fishery ecological studies, survey of port and harbour areas for routine data collection needed for developmental works and maintenance, marine

environmental monitoring for oceanographic studies, coastal engineering works and aquaculture.

2.18 Ship borne data acquisition system

The system consists of a single meter with multi-channel measurement facility and its sensors, which are connected to the meter permanently or temporarily, as and when needed. This instrument is used for monitoring marine environmental parameters on board fishing vessels related to marine meteorology, water quality and performance of the vessel. Three models of the equipment are available for operation on small, medium and large vessels.

2.19 Environmental data acquisition system

The instrument consists of remote operated sensors for sensing 16 environmental parameters directly and indirectly related to aquaculture engineering and fishery ecological studies. The data are displayed in a digital meter with provision for recording or storing as needed. Selection of parameters are flexible also. Few of the parameters incorporated in this instrument are Water level, Water temperature, Water current, Water salinity, Solar radiation under water (PAR), Air temperature, Wind velocity, Wind direction, Relative humidity, Atmospheric pressure, Solar radiation, Rain fall.

2.20 Solar radiation monitor and integrator

The instrument consists of remote operated sensors for indicating solar radiation of photo synthetically Active Region (PAR) and a digital display meter for indicating the light intensity in LUX and solar energy in μ En/m^2/sec. It monitors solar radiation in the PAR range and integrate the same over long durations of hours, days or weeks which will be used

for solar energy vs photosynthesis studies in aqua and terrestrial systems, solar energy measurements in solar plants, solar ponds and related programmers. No need for cosine correction as the sensor is free from cosine errors.