

**Proceedings of the 12th National Symposium of ISCAR on
“Coastal Agriculture: Boosting Production Potential under Stressed Environment”
held at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra
during 28th Sept. – 1st Oct. 2018**

The 12th National Symposium of the Indian Society of Coastal Agricultural Research (ISCAR) was held at Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra from Sept. 28 to Oct. 1, 2018.

The symposium was inaugurated by Dr. A.S. Dhawan, Hon'ble Vice Chancellor of Vasant Naik Marathwada Krishi Vidyapeeth, Parbhani as Chief Guest, Dr. S.B. Kadrekar, Ex-Vice Chancellor of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli as Guest of Honour and was presided over by Dr. K.P. Viswanatha, Hon'ble Vice Chancellor of Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli.

The symposium was held across 4 days with six sessions that dealt with various aspects of coastal agriculture as follows:

Session I	Advancement in natural resources management for sustained productivity	Chaired by: Dr. N.K. Tyagi Co-chaired by: Dr. B.K. Bandyopadhyay
Session II	Crop production technologies for agricultural and horticultural crops under stressed environment	Chaired by: Dr. D. K. Sharma Co-chaired by: Dr. P.C. Sharma
Session III	Technological advancement in aquaculture and livestock production systems for higher productivity	Chaired by: Dr. S. Dam Roy Co-chaired by: Dr. Hukhum Singh Dhaker
Session IV	Climate change, ecological threat, biodiversity and coastal forestry management, and preparedness to forewarn disaster and suggestion to mitigate miseries along with adaptation measures	Chaired by: Dr. NP Singh Co-chaired by: Dr. D. Dutta
Session V	Technology impact, markets & institutions, ICTs and eco-tourism for better livelihoods	Chaired by: Dr. S.G. Bhawe Co-chaired by: Dr. B. Maji
Session VI	Coastal agriculture, horticulture, aquaculture, livestock and forestry in Konkan region – Performance, challenges and options	Chaired by: Dr. P.M. Haldankar Co-chaired by: Dr. K.D. Patil

ISCAR also organized a lecture in memory of Padma Shri Late Dr. J.S.P. Yadav, an eminent soil scientist. During this symposium on 28 Sept. 2018, the 2nd Dr. J.S.P. Yadav Memorial lecture was delivered by Dr. N.K. Tyagi, Ex. Member, ASRB, New Delhi and Former Director, ICAR-CSSRI, Karnal on “Towards a green deal for coastal ecosystem with special reference to Sundarbans under Climate Change”.

Special lectures by eminent researchers were also organised during the symposium. Dr. P. K. Joshi, Director Asia, International Food Policy Research Institute (IFPRI), New Delhi delivered a special lecture entitled “Agricultural transformation in India: policy, challenges and opportunities” on 28 September, 2018. Another lecture on “Use of space technology in climate studies - an ISRO initiative” was presented by Dr. D. Dutta, Scientist/Engineer – G and Group Director, NICES, NRSC, Hyderabad on 29 Sept. 2018.

A panel discussion on Transforming coastal agriculture towards ‘doubling farmers’ income: policy perspective for coastal region’ was also held where the panellist discussed on the technology, policy and institutional issues with reference to situations prevailing in coastal region and came out with a

road map for transforming the farmers' livelihoods in the coastal region. This discussion was chaired by Dr. N.K. Tyagi and co-chaired by Dr. P M Haldankar , Director Research, DBSKVV, while Dr. D K Sharma, Former Director, ICAR-CSSRI Karnal, Dr. S G Bhawe, Director Extension, DBSKVV, Dr.Hukam Singh Dhaker ,Dean ,Fisheries, DBSKVV, Dr. S Senapati, Asst. Professor, CIMP Patna, Dr. A R Desai, Principal Scientist, ICAR-CCARI, Goa and Dr. S Mandal, Principal Scientist, ICAR-CSSRI-RRS, Canning Town were the panelists.

During the symposium various honours and awards were also conferred by the society to outstanding researchers working in the field of coastal agriculture. The ISCAR fellow award was conferred to Dr.Sibnarayan Dam Roy, Principal Scientist and Former Director, ICAR-CIARI, Port Blair, Dr. R. K. Singh, Senior Scientist and Rice Breeder, International Rice Research Institute (IRRI), Philippines, Dr. Jitendra Sundaray, Principal Scientist, ICAR-CIFA, Bhubaneswar and Dr.R.K.Gautam, Principal Scientist, ICAR-CIARI, Port Blair. The Dr. J. S. P. Yadav Best Paper Award for the years 2015-2017 was conferred to Davis Sibale, M. S. Mane, S. T. Patil, B. L. Ayare and V. S. Desai for their research paper entitled "Effect of Mulching and Irrigation Levels on Soil Temperature, Soil Moisture and Yield of Drip Irrigated Cauliflower" published in 2015 in the Journal of the Indian Society of Coastal Agricultural Research, Volume 33 No.2, page 28 to 35.

The Dr. H. S. Sen Best Poster Presentation Award was awarded to A.D. Adsul, P.S. Shelar, M.M. Shinde, A.A. Shelke, S.T. Indulkar and M.S. Sawant for the paper entitled "Seasonal variation of green seaweeds (Chlorophyta) from the Undi coastal area of Ratnagiri, Maharashtra" adjudged as the Best Poster Presented during the Symposium. Besides four other best poster presentation awards were also given to the participants ("Studies of the effect of different concentrations of growth regulators on root and shoot production of Kokum grafts (*Garcinia indica* Choisy)" by S.B. Pachane, G.D. Shirke, D.T. Kolekar, J.S. Dhekale, S.G. Mahadik, P.M. Haldankar and B.R. Salvi; "Use of soilless media for raising mango grafts - an innovative solution on soil scarcity for nursery industry by O.A. Lad, M.S. Khapare, M.M. Kulkarni, S. G. Ragaji, M.M. Burondkar, D.T. Kolekar, R.G. Dhopavkar, V.S. Desai, N.B. Gokhale and P.J. Kshisagar"; Effect of ethanolic groundnut husk extract on functional characteristics of pink perch (*Nemipterus japonicus*) surimi" by S.D. Meshre, S. B. Patange and S. Shah; "Utilization of Waste Heat for Production of Power Based on Seebeck Principle" by S.V. Aware, A.G. Mohod, P. Kolthurkar, Y. Jadhav and V.V. Aware).

At the end, during the plenary session, which was chaired by Dr. H.S. Sen, President of ISCAR, the summary of the deliberations and recommendations were presented by the rapporteurs for the different sessions.

The symposium was attended by more than 150 delegates comprising of researchers, academicians and students from various parts of the coastal states of India. The Symposium was supported by the Indian Council of Agricultural Research, New Delhi as the major sponsor.

The recommendations that emerged out of the deliberations during the symposium are given below.

Gaps identified	Recommendations
The planning, design and operationalization of estuary management practices are based on complex hydraulic phenomena. Some of the identified research and data gaps include: estuary regime modelling for design of protection structures, hydro-salinity modelling to settle the competing issues crop vs brackish water aquaculture, mapping of coastal ecosystem resources for natural capital accounting	Creation of freshwater reservoir through estuary closures, tidal river management (TRM) for removing drainage congestion and reducing flood hazards; and extending farming into off coast sea through open and closed 3-D farming systems, are some of the possible interventions to reduce biotic and abiotic stresses and promote sustainability. Ecosystem management strategies, besides ensuring provisions, will yield co-benefits that meet multiple goals, including carbon sequestration, assimilation of pollutants, and watershed protection.

	To arrive at harmonized outcomes from these interventions, analytical frameworks and methods are needed for assessing vulnerability of coupled human-environment systems, and the ability of the social and environmental components of such systems to adapt to change.
Assessment and monitoring of the coastal eco-system using conventional techniques are time consuming and resource intensive.	Remote sensing techniques have been found to be useful in rapid monitoring of land use changes, climate change impacts and ecosystem dynamics. The strengths of remote sensing technology should be harnessed to assess and monitor the coastal ecosystem for development of sustainable coastal zone management plans.
Soil salinity has been projected to increase significantly by the year 2025, causing huge economic losses. Salinity accounts for about 5.11 million tonnes of food grain losses annually in the states of Gujarat, Maharashtra, West Bengal, Andhra Pradesh and Odisha leading to economic losses to the tune of 7370 crores annually.	In order to prioritize and target reclamation measures, use of emerging tools like high resolution and hyperspectral remote sensing should be used for rapid and accurate assessment.
Soils exhibit sodicity problems in certain regions even when the ESP is less than 15%.	It is essential to revisit this critical level in relation to soil texture, content and nature of clay.
The changes in water quality and sedimentation are very dynamic in estuaries. Time series data are needed to make objective assessment.	It is recommended that programme to monitor water quality, environmental flows and sedimentation rates be established at identified critical locations in the estuaries.
There is a need to evaluate the synergies and conflicts arising due to water and land use management in coastal zones	Hydro-salinity modelling in areas, where crop and brackish water aquaculture on large scale is being undertaken, should be initiated to study impact on cultivated lands. This will enable to evaluate the synergies and conflicts of crop and brackish water aquaculture to properly manage the coastal zones.
Many of the coastal areas despite receiving high rainfall during the monsoon also face water scarcity particularly in the dry season.	A regionally- differentiated strategy is suggested for increasing water availability. Konkan region: constructions of serial check dams across the secondary and tertiary streams to store water and construction of well close to check dams; Andhra and Tamil Nadu coast: Skimming wells and solar pumps are recommended; Sundarbans: Bore well fitted with solar pumps are recommended.
Removal of drainage congestion in flat cultivated lands of coastal areas through land surface modification and also sub surface drainage is now a proven technology which also helps in salinity control. However this involves high initial investment. Therefore, adoption of this technology by individual farmers is a constraint.	These technologies should be promoted on a large pilot scale through government programmes like RKVY, PMKSY, MGNREGS, etc., and other specifically designed schemes by the government for their long-term sustainability. Also mole drainage technology with appropriate cropping sequence reduces the reclamation cost to Rs. 2500 – Rs. 3000 per hectare and increase the income of the farmers in Western Ghats up to Rs. 2 Lakhs per hectare with BCR of 2.31.
Government of India is now focussing on more crop per drop therefore, technology for irrigation water saving, yield maximization and use of poor quality	Due attention should be given for development of a spatial database on water resources availability, crop yield potential and yield gap in order to target location specific management decisions for improving water productivity.

<p>irrigation water in horticultural crops are required. Water saving irrigation scheduling and fertigation with drip irrigation can increase yield of horticultural crops such as papaya to more than 200 t/ha.</p>	<p>Micro-irrigation techniques coupled with mulching should be given priority for horticultural crop production in the coastal region for irrigation water saving, yield maximization and use of poor quality irrigation water. Financial assistance is required for rapid propagation of micro irrigation technologies for efficient use of limited water resources.</p>
<p>Drip irrigation is a point source application technique. While large amount of data is being generated on production aspects, information on moisture/ salt/ root distribution/ clogging which are required to decide the rate of application are missing, and need incorporation in the observation schedule.</p>	<p>There is a need for incorporation of these parameters in the observation schedule.</p>
<p>The coastal regions are considered to be highly vulnerable to the impacts of climate change particularly sea level rise. Farmers in the coastal region are facing yield loss due to aberrations in weather conditions.</p>	<p>It is imperative to study the impact of climate change on crop, fish and livestock. Effect of climate change should be taken into consideration for framing farming policies depending on level of resilience at different locations. For mitigating agricultural risk farm level coping strategies should be supported and replicated for larger group of farmers. There is an urgent need for yield forecasting by the use of long term weather based validated multivariate regression models to estimate yield losses and aid in decision making for formulating coping strategies.</p>
<p>Under futuristic climate change scenario, crop ET and water requirement is predicted to increase significantly.</p>	<p>There is a need to include the effect of elevated temperature and CO₂ on crop physiology to have more realistic estimates of water requirement under climate change scenario and sustainable water management would be the key researchable issue to offset climate change impacts.</p>
<p>Coastal agriculture faces multiple stresses- salinity, waterlogging /submergence, drought, heat, etc., within a growing season and this is expected to aggravate under changing climate.</p>	<p>There is urgent need for development of crop varieties tolerant to multiple stresses. The emerging triode of bio-, nano- and information - technologies should be leveraged for faster development of such varieties. Dual tolerant or two in one rice varieties such as BR 78 and Salinas 22 have been developed which can tolerate salinity as well as submergence. CR dhan 405 is the recent reproductive stage salinity tolerant variety for high saline areas and CR 1009 -Sub 1 can be recommended for flash flood prone coastal areas. Research agencies are developing stress tolerant high yielding varieties of field and horticultural crops, there is urgent need for government support for large scale multiplication of good quality seeds, because there is shortage of seeds of these crops in stress prone environment. Conservation agriculture should be promoted as a climate resilient technology. Work on conservation tillage practice in Sundarbans region revealed that Carbon Footprint (CF) of rice-rice system was less than rice-cotton systems. When CFs were calculated considering the soil organic C sequestration, reduced tillage with residue was estimated to have minimum CF among all tillage treatments and it could be a preferred climate resilient technology for lowering CFs and enhanced</p>

	ecosystem services of climate regulation for rice based cropping systems in coastal regions.
Low income of farmers in the coastal region due to various production constraints prevalent in the coastal region (salinity, water logging, non availability of good quality irrigation water, high production costs, etc.)	<p>Alternate crops such as bio fuels, halophytes, sea weeds, etc., should be promoted for cultivation in the highly degraded salt affected soils where growing of agricultural crops is not possible. The agronomy of such crops needs to be studied and should be given due attention.</p> <p>Several farm machinery and equipments like, paddy transplanter, mulch laying and planting machine, power operated weeder, etc., have been developed and tested for use in the coastal region. Due attention should be given to farm mechanization for reducing input cost and drudgery.</p> <p>Agro-tourism/ Eco-tourism needs to be promoted wherever possible and due care should be taken not to damage the natural resource base. This will help the farmers to increase their income by several folds.</p> <p>Technologies for highly profitable horticulture and raising of ornamental fish are readily available and best suited for coastal areas; and should be taken advantage of to increase farmers income.</p> <p>Floriculture and agro-tourism, Integrated Farming System (IFS) with right mix of agri-enterprises, risk cover, post-harvest processing and market linkage through FPOs are the driving factors for improvement of income of the farmers in the coastal region.</p> <p>Demand of organic food is increasing; however, urgent need is to design improved marketing facility and remunerative price for organic produce in coastal region.</p> <p>Government should develop appropriate post harvest processing and market infrastructure for horticultural commodities.</p>
Low productivity in the aquaculture sector despite the availability of improved production technologies.	<p>Integrated farming system approach involving promising germplasm from plant, animal and fish component is required to be adopted.</p> <p>Diversification of the candidate species for brackish water aquaculture, mariculture and freshwater aquaculture needs to be encouraged to enhance production. It was felt that cage culture of fin fishes, raft culture of mussels, oysters and seaweeds needs to be done in offshore areas to boost up production.</p>
Lack of data pertaining to vulnerability of the coastal ecosystem to environmental changes and on consequent economic and livelihood issues	Analytical frameworks and methods are needed for assessing vulnerability of coupled human-environment systems, and the ability of the social and environmental components of such systems to adapt to change.
Current food supply chain is unorganised, fragmented and insufficient. High transaction costs, high losses are leading to rise in prices along with low processing and poor safety concerns.	Marketing infrastructure needs to be addressed. Diversification of agriculture, integrating with global market and agro processing and climate smart agriculture are some of the issues which can be seen as opportunities for transformation of coastal agriculture.
In the coastal region valuation of marketable services is available, but very little work has been done for generating information on valuation of non-market services.	Value of all the ecosystem services have to be accounted for and used while formulating the policies for sustainable development of the coastal eco-system.

Doubling farmers' income by 2022, is the Government of India's declared objective which reflects a paradigm shift from the hitherto fore emphasis on farm production to farm income. Realizing, how important this issue is for millions of poor small farmers and fishers, who eke out their livelihood from progressively declining natural resources and increasing biotic, abiotic stresses induced by anthropogenic and climatic factors, a panel discussion was organized on "Transforming coastal agriculture towards doubling farmers' income: policy perspective for coastal region". It was felt that that transformation in any sector cannot be achieved through incremental changes and coastal agriculture is no exception to it. It would require transformative changes in technologies as well as in the policies to mainstream the technologies in development programmes for out-scaling.

The panel discussed these various interconnected technology policy and institutional issues with reference to situations prevailing in coastal region. Based on the valuable inputs from the learned panelists and the brief interventions made by the other participants the following salient recommendations were drawn out.

- Technologies for high-tech horticulture and raising of ornamental fish are readily available and best suited for coastal areas; and should be taken advantage of to increase farmers income.
- In coastal areas, crop-based farming systems have relatively lower potential than aquaculture centric farming. Integrated studies of land, sea, capture and culture fisheries, and coastal forestry are lacking, and need urgent attention.
- Multi-stress tolerant crop varieties: Coastal agriculture faces multiple stresses- salinity, waterlogging, drought and heat etc, within a growing season, and hence the need for Multi-stress tolerant crop varieties. The emerging triad of bio-, nano- and Info- technologies should be leveraged for faster development of such varieties.
- The engagement of stakeholders in development of research agenda is a critical step towards creating a more efficient and implementable programme, suiting to the needs of the regions. It is therefore important that the research programmes are drawn with wider consultation, involving the active participation of the farmers/fishers, industry, consumers, researchers and policy makers.
- Research in coast and off-coast farming is facing multiple stresses, and being most affected by climate change is a costly undertaking, and require stepped up funding
- Estuaries, which are common property resource is often mismanaged. In view of large number of stakeholders with different interests in the common property, there must exist a sound policy framework to guide the development, use and rejuvenate the coastal ecosystem.
- Extending farming to near and off-coast areas offers a good solution, for as sea farms can be designed to restore ocean ecosystems, mitigate climate change, and create blue-green jobs - while ensuring healthy, local food for communities. The system being capital intensive, would require financing policy to be put in place.
- Unlike land, there are no well laid down policies for leasing water areas in estuaries and off-coast sea areas. Since development of off coast farming is capital intensive and requires high capital investment, there is an urgent need to formulate sea area leasing policies.
- The high value products of coastal areas include fish, fruits and flowers, which are highly perishable. Establishment of food value chains and markets is necessary for increasing farmers' income and reducing resource use.

Sd/-
Dr. D. Burman
Secretary, ISCAR

Dated: 28.12.2018