SUMMARY & CONCLUSION

The present study covers a wide range of issues in respect of production and productivity in different types of water bodies, management of resources, plan allocation and expenditure as well as projects taken up for development of fishery sector with special reference to external funding, fish and fish seed production, potential productivity and gap areas for intervention for sustainable development.

Fish production in the state during 2011-12 was 2.45 lakh t. In national perspective, the state with 2.32 lakh t of fish production in 2010-11 contributed about 2.78% of the country's total inland fish production of 78.51 lakh t. Assam is the 5th highest producer of fish and 2nd highest of seed in the country. The fishery sector in Assam contributed 2% of state's GDP during 2010-11. The per capita fish consumption in the state at present is about 7.58 kg/year.

The fishery as independent department came into being only in 1991. The present man-power of the Department is only 1337 personals with 739 technical and 598 non-technical staff. However, there is ample anomaly in staff strength amongst similar level of offices in sub-divisional, district and zonal offices throughout the state. Large number of existing vacancies to the extent of 23% of the staff strength of the Department, which is already reeling under acute man power shortage, is a matter of concern.

Department of Fisheries has taken up a number of initiatives to develop this sector and also to improve the socio-economic status of the poor fishers and fish farming communities of the state. The fund for these programme are presently being availed under State Plan, Rastriya Krishi Vikas Yojana, Assam Agricultural Competitiveness Project, and various Central Sector Schemes as well as schemes
under National Fisheries Development Board (NFDB). The total annual infusion of fund through public sector investment to this sector for development initiatives is around Rs.50 to Rs.60 crores at present against the initial investment of Rs.10.50 lakh during the period of 1951-55.

Government of Assam has so far availed three externally aided projects viz. (i) World Food Programme (WFP) during 1986-97 (ii) Assam Rural Infrastructure and Agricultural Services Project (ARIASP) during 1995-2004 and (iii) Assam Agricultural Competitiveness Project (AACP) during 2004-12 with total expenditure of Rs.4600.00 lakh. Physical achievement was development of Farmers' Ponds, Community tanks, integrated farming projects and beel fisheries with total coverage of 4300 ha, short duration training to about 30,000 farmers and 1168 officers. There was over 200% to 400% increase in farm productivity under different components. The AACP has been extended with additional financing for three years from 2012-15 to upscale the activities taken up during first phase of AACP. The programme will be implemented only in 12 districts of the state unlike all districts taken up during first phase of AACP.

A good number of agencies are also directly or indirectly involved in the development of fishery sector in the state. Notable among them are the ICAR institutes like Central Inland Fisheries Research Institute (CIFRI), Central Institute of Freshwater Aquaculture (CIFA), Central Institute of Fisheries Education (CIFE), Central Institute of Fisheries Technology (CIFT), North Eastern Council (NEC); nationalized Banks (SBI and UBI in particular); Assam Fisheries Development Corporation (AFDC) Ltd.; FISHCOFED; FISHFED and different Non-Government Organizations. In addition, contribution of private sector in the areas of seed
production, production of fish feed, fish production, marketing of fish etc. is also noteworthy.

The study on 56 beel fisheries developed under AACP revealed that out of 8772 BDC members, 1979 members i.e. 22.56% were female. Caste wise, SC is 9.13%, ST 39.58%, OBC 30.75% and General 20.54%. In respect of land holding among beel users, landless constitutes 27.51%, small farmers 24.21%, marginal farmers 47.66%. This may be the general demographic pattern of people around beel fisheries in the state.

Closed beels are the ideal bodies for practicing culture-based fisheries management being very rich in nutrients and fish food organisms, which enable the stocked fishes to grow faster. They allow higher stocking density by virtue of their better growth performance and there are no irrigation canals or spillways, which often cause the stock loss. In a culture-based fishery, the growth is dependent on stocking density and the survival is dependent on size of the stocked fish. The right species stocked in right number, of right size and their recapture at right size are the determining factors. The basic management strategies are: (i) size at stocking, (ii) stocking density, (iii) size at capture / selection of fishing gear, (iv) species management and (v) selection of species.

In capture fisheries the wild stock is harvested with little intervention on habitat variables or the biotic communities. On the other hand in culture fisheries, the whole operation is based on captive stock with a high degree of effective human control over the water quality and other habitat variables, whereas the fish harvest in open water system depends mainly on artificial recruitment, it is referred to as a culture based fishery. The size at stocking, grow out period and the size at capture are the important criteria in culture based fishery management.
Commercial aquaculture in the state having 38775 ha of ponds and tank fisheries, is mostly confined to the districts of Barpeta, Cachar, Dhubri, Kamrup, Karimganj, Lakhimpur Morigaon and Nagaon which are contributing 53.75% of state’s fish production. The state’s position in respect of overall fish and fish seed production in the country is 6th and 2nd respectively. Although there is considerable increase in both fish seed and fish production in the state over the years, there exists a considerable gap between supply and demand of fish. The shortfall in case of food fish is about 0.90 lakh ton annually. The pond and tank fisheries in the state contribute about 45% of state’s total fish production annually. Commercial fish production in Assam is almost exclusively in the hand of private sector while contribution of Government sector of both the cases is negligible. The farmers in the state generally follow composite fish culture practice as introduced by CIFRI under All India Coordinated Research Project (AICRP) during 1974-75.

The study indicated that the average size of farmers’ pond in the state is 0.09 ha where the present level of production was 1500-1800 kg/ha/yr. Through adoption of semi-intensive farming practices, the productivity has been enhanced to an average of 3250 kg/ha/yr. However, production level up to 4500 kg/ha/yr has also been achieved by farmers in some quarters of the state. Besides culture of Indian Major Carps and exotic carps under composite culture system, in many places, culture of bata (*Labeo bata*), Java puthi (*Puntius javonicus*), pangas (*Pangusia pangusia*) in the districts of Barpeta, Cachar, Kamrup, Morigaon and Nagaon have been taken up by farmers on commercial scale. Culture of banned fishes like big head (*Arichthys nobilis*), Thailand magur (*Clarius gariepinus*) and tilapia (*Oreochromis mossambica*) is also going on in districts like Barpeta, Kamrup, Karimganj, Morigaon, and Nalbari.
Out of 15,549 beneficiaries supported under AACP, 463 were Community Tanks Groups (CTG). The community wise breakup is: SC - 7.85%, ST- 33.56% and General- 58.58%. In respect of land holding, landless farmers are 46.07%, small farmers 17.24% and marginal farmers 36.70%. Out of total 15549 beneficiaries under Community Tanks, 8.71% are women. In respect of Farmers Pond and Integrated farming covering 1812 CIGs under AACP, SC is 10.95%, ST 19.57% and General 69.48%. In respect of land holding, landless farmers are 57.46%, small farmers 16.85% and marginal farmers 25.68%. Out of the total of 26372 beneficiaries, women constituted 11.08% under Farmers’ individual Ponds.

The quality of fish seed in the state is sub-standard because of in-breeding and that too from undersized brood fish. A happy sign is that a number of hatchery operators in the state are now interested to replace their old brood stock with fresh lot from natural sources to improve quality of fish seed. The private sector is contributing over 95% of seed production in the state. Although there is considerable increase in fish seed production in the state over the years, there exists a considerable gap between supply and demand of fingerling. The shortfall in fish seed (fingerling) is still about 300 million.

Investment by Fishery Department during the last 60 years has also increased considerably from Rs.10.52 lakh in 1951-56 to Rs. 6855.29 lakh in 2002-07 indicating 651.64 times hike. Corresponding increase in expenditure was from Rs.10.52 lakh to Rs.3925.33 lakh (373.13 times). Main development programmes taken up by the Department were fish seed production, development of derelict water bodies, pond and tank fisheries, development of scheduled caste and scheduled tribe farmers through financial assistance and extension services to the farmers in the field. More recently, infrastructure development like construction of districts and sub-divisional
Meen Bhawan (office houses) and support to entrepreneurs to construct fish feed mill has been taken up by the Government. Major development programmes taken up by State Government were the three Externally Aided Project (EAP) viz, the World Food Programme (WFP) for development of beel fisheries during 1987-96 with financial involvement of Rs500 lakh, Assam Rural Infrastructure & Agricultural Services Project (ARIASP) for poverty alleviation of rural fish farming communities from 1995-2004 with financial involvement of Rs. 2200 lakh and Assam Agricultural Competitiveness Project (AACP) with main objective of poverty alleviation from 2004-12 for Rs.4800 lakh with additional financing of Rs.3708 lakh for 2012-15. These included development of 34 beel fisheries covering 4544 ha in 7 districts under WFP. Post-development productivity increased from 173 kg/ha/yr to about 400-450 kg/ha/yr. Under ARIASP, 1635 ha of pond and tank fisheries and 2299 ha of beel fisheries were developed with livelihood enhancement of 5904 fish farmers in addition to infrastructure development of 6 training centers.

During first phase of AACP, 2964 ha of pond and tank fisheries and 995 ha of beel fisheries were developed with coverage of 36322 beneficiaries throughout the state. Individual farmer’s income raised considerably from Rs.10883/- during pre-development period to Rs.23716/- per ha after development intervention in case of pond fisheries, Rs.3558/- to Rs.7323/- in case of community tank fisheries, Rs.22175/- to Rs.77020/- in case of integrated pig-fish farming, and Rs.1586/- to Rs.6585/- in case of beel fisheries. The major impact of these EAP programmes are the realization of the farmers about the utility of stocking bigger sized seed and application of farming inputs like lime and fish feed for the growth of fish and thereby increase in farm output and community concept of wetland management for sustainable livelihood.
The ICAR Institutes like CIFRI has been engaged in capacity building of technical officers in the department, officers of AFDC, lessees of beel fisheries and other stakeholders, technology innovation and its transfer and demonstration in beel fisheries through its NE Regional Centre at Guwahati. Similarly, CIFA is involved in training of officers of the state, technology innovation and its transfer including distribution of fabricated portable FRP hatcheries for IMC and magur seed production to the farmers and the Department of fisheries, Assam. NBFG (Lucknow) has been involved in conservation of threatened/endangered fishes in the state for which the institute has set up one Regional Live Gene Bank at Guwahati in collaboration with the Department of Fisheries. The contributions of financial institutions like banks in increasing in the form of lending loans to farmers, though at lower pace. The main financing banks in the state in fisheries sector is the State Bank of India and United Bank of India. The role of insurance companies is very important in fisheries development but present level of insurance support is poor. Support from National Co-operative Development Corporation (NCDC) for development of fishermen cooperatives in Assam is almost negligible. State Institute of Rural Development (SIRD) has been occasionally providing capacity building of technical officers of the Department on different aspects. The District Rural Development Agencies (DRDA) has been implementing fishery programmes in the construction of pond/tank fisheries and fish seed hatchery construction in different places in the state. National Fisheries Development Board (NFDB), Hyderabad, has been extending financial support for infrastructure and water area development programmes as well as extension activities under both Government and private sector. Total fund released by NFDB to the state since inception is Rs.285.87 lakh against sanction of Rs.372.95 lakh. This has helped in construction and improvement of 150.22 ha of pond and tank fisheries,
establishment of 7 IMC hatcheries, one fish feed mill, training of 150 farmers, organize 50 block level awareness programmes, supported construction of 3 freshwater prawn hatcheries and taking up other programmes.

As far as human recourse development is concerned, College of Fisheries (CoF), Raha established in 1987 and one of the 16 fishery colleges in the country, is engaged in technical man power development mainly. With annual student intake capacity of 20, the CoF has so far awarded B.F.Sc degree about 350 students of the state. Assam Agricultural University (AAU) is supporting fisheries development through capacity building, formulation of package of practices for fish farming and also engaged in different research works. The fish farming package of practice for pond & tank fisheries designed by AAU for ARIASP during 1995-96 is still in practice by the farmers in the state. In addition, a fish feed mill was established by AAU with financial support from the Department of Fisheries under ARIASP in the year 2000 to formulate fish feed with local ingredients. The mill is successfully operating now. The three universities in the state, Gauhati, Dibrugarh and Assam University have fisheries science in their post graduate curricula and all three universities have been carrying out different aspects of research related to fisheries.

A number of SHGs have been formed in different districts and engaged in fish farming with or without Government support. The NGOs are performing social mobilization under externally aided project of AACP. Few NGOs are engaged in fish farming activities while a number of NGOs are working on fish biodiversity conservation. The status of fishermen co-operative societies in the state is very poor. Most of the societies are running at loss as per the records available with them. There are 6 fish feed mills in the state under private ownership producing fish feed in the
form of dust and none producing feed of pellet type. The production capacity of these mills is low and meeting a small percentage of feed requirement of the state.

Studies on the 56 wetlands indicated growth of unwanted biotic communities with dominance of aquatic macrophytes (submerged, floating and emergent) in most of the beels in the state. However desired management practices are not followed in the registered beel fisheries resulting poor productivity. Further, management practice followed by Government in the form of leasing out 60% fisheries to co-operative societies is ambiguous. This is because, the present study on 56 wetlands indicted that only 3.57% of scheduled caste (major fishing community) people are inhabitants in the periphery of beels. This results in engagement of fishing parties from distant places by the lessees of the beels, depriving livelihood of the local communities around the beel. This suggests a detail study on demography of beel areas to take up a reasonable leasing policy in wetland management.

During last 4-5 years, a considerable progress has been noticed in the implementation of the provision of Assam Fishery Rules, 1953. This is mainly due to empowerment of fishery officials to implement rules. However, illegal catching of fish fingerling to a considerable extent has been continuing in places like (i) Panchgram (confluence of river Barak with Katakhal river in Hailakandi district), (ii) Jarabari-Bartari-Bhuturi and Bejorkuti (Kamrup district), Jayantipur (Goalpara district), Chataijan and Tinikharia (confluence of Gipota rivulet with Brahmaputra in Sonitpur district), Kaziranga wildlife sanctuary and probably in many other places. This requires immediate Government intervention for effective implementation of the provisions of the Assam Fishery Rules, 1953 and Assam Fish Seed Rules, 2010. Detail survey of fish breeding grounds and specific seed collection centers need to be taken up for declaration of sanctuaries for conservation of fish biodiversity and
sustainable management of capture fishery resources in the state which is a biodiversity hotspot in the world. Similar may be the situation in case of fish seed production. The actual production level of three categories of fish seed like spawn, fry and fingerling also need to be ascertained.

Production of pond and tank fisheries as per survey of Fishery Department (2004) is 1500 kg/ha/yr. No study was made subsequently except recording of fish production data under the on-going AACP which indicated productivity range of 2850-4000 kg/ha/yr with average of 3250 kg/ha/yr. The area developed under ACCP under ponds/tanks being 2964 ha, the increased production would have little impact on overall production in the state. Likewise, increased average production of 1027 kg/ha/yr achieved in 995 ha beel fisheries under AACP against the average production of 173 kg/ha/yr (CIFRI, 2003) in the beel fisheries again will have negligible impact in overall fish production of beel fisheries.

Under the situation, the fish production of Assam from three major resources like pond/tanks, beel fisheries and river fisheries stands at 77,960 ton annually against the Department of Fisheries report (2011) of 184620 ton from these three types of water resources for the year 2010-11. The fish productivity potential in Assam is worked out to be 4.04 lakh ton under presently adopted farming practices with timely and required level of availability of inputs. Obviously, the potential productivity varies under different farming practices.

The most impact making development programmes ever implemented by the Department is the on-going AACP. The project has been running with effective involvement of local community in every stage of development process, complete transparency and high level of monitoring followed by modification in management
process whenever required. This has generated a reward bestowed on the Fishery Sector by World Bank with 1st prize under the project.

Study on plan allocation and expenditure over a period of 55 years since 1st Five Year Plan (1951-55) to 10th Five Year Plan (2002-07) indicated a staggering 651.64 times jump in allocation and 373.13 times jump in expenditure. While major share of expenditure (about 90%) was incurred for salary component, actual fund allocation for development component started flowing since 2006-07. The project proposal for development of fishery sector under RKVY indicated investment of Rs.728 crores for five years to give additional production of 70,000 tons of fish annually. However, the Department is provided an allocation of about Rs.10 crores to Rs.15 crores annually under this programme. This level of allocation will never help the sector in achieving self sufficiency in fish production in the state. Adequate flow of fund for development of this sector on a time frame with Mission Mode under Perspective Plan is an urgent need.

Additionally, a sector should have a clear vision to achieve certain goal towards its overall development. Ad-hoc planning process followed since inception of this Department would lead to nowhere. The planning process needs immediate overhauling and replaced with actual resource based target oriented specific time framed planning. Further, monitoring of development programmes on a regular basis in the field itself and its evaluation is essential. This is almost lacking in the Department for various reasons. This has also relation to the manpower strength of the Department. The Department is seriously suffering from poor staff strength. A practical assessment of man power requirement need to be made for strengthening of the Department as the fishery sector with vast water resources is one of the most
potential area in Assam for employment generation and livelihood enhancement of poor fishers of the state.

The study conducted so far on fishermen co-operative societies indicated that most of the fishery co-operatives are running at loss and as a whole, fishery co-operatives in the state are in complete disarray. The fishermen co-operatives need to be under the total management control of the Fishery Department which has adequate technological expertise and experience in management of common property resources through involvement of local rural community.

There is need to strengthen scientific research on wetlands as there are large numbers of scientific and technological issues such as wetland ecosystem research, conservation and restoration techniques research, in practical work, to be resolved. This should be followed by a strong technology support system. Simultaneously, there is need to increase investment, the introduction of qualified personnel and other measures to strengthen the capacity of the existing scientific research institutions and implementing authorities and gradually establish and improve the wetland science and technology support system. There is also need to integrate existing scientific and technological strength, the establishment of an interdisciplinary, inter-departmental mechanism for joint research, to create a wetland ecological monitoring system; to select rational use of optimization model experiments and demonstrations, study and exploration of degraded wetland ecosystem restoration and reconstruction of the technology; maintenance of ecological safety of the total wetland resources in an effective manner. Resumption of the original wetlands on the basis of research with efforts to increase wetland area for ecological health upgradation should be taken up.
Fish conservation is a social instruction, which is fixed by acts of nature conservation and further described by the regional regulations. The necessity of these instructions is generally accepted by the society. Variety of approaches is used to promote fish conservation and community-based approach is one of them. Community based fish conservation programmes witness multiple stakeholders operating at multiple levels and varying distances from the targeted resource. The active participation of these stakeholders who interact with and depend on fish for economic and cultural purposes is invaluable for the success of fisheries management in different inland open water systems.

Coordination between allied departments/institutions is very important for development of a sector. This is practically lacking everywhere. There is an urgent need of coordination among Fishery Department, Panchayat & Rural Development Department, Assam Fisheries Development Corporation Ltd., Water Resource Department and FISHFED who are directly or indirectly involved in the development and management of fisheries as a whole in the state.

Specific plan for the wetland protection as national key ecological project may be formulated. The wetland protection and management is directly related to wetland restoration, wetland construction and management areas, wetland science, publicity, education and personnel training, among other things a comprehensive and systematic approach throughout the country have not yet been started as practically there is no specific protection and management programme except notifying some acts/rules for wetland protection at different times. The country like China has already taken up "National Wetland Protection project implementation plan," with clear, specific objectives of wetland protection and construction priorities.
Successful ecosystem management usually depends upon creation of partnerships which can be established between different sectors and stakeholders and NGOs, etc. If the local communities are assured that they have legal rights of access, they will be willing to put more effort into managing their ecosystems and safeguarding their natural resources. Ecosystem management agreement, therefore, warrants a clear definition and legal recognition of access rights for local communities and other stakeholders. It is more appropriate to work with the existing groups of stakeholders, rather than trying to create new interest groups. It is must to bring together representatives of the various stakeholders for the purpose of making collaborative management decisions, coordination between different stakeholders, information sharing, build capacity of local institutions and community groups, reviewing progress, resolving of conflicts and assume responsibility for long term implementation of ecosystem management activities.

Fishery scientists need to see beyond fish and water body to the entire catchment and recognize the links between fish and land, fish and the forest, and fish and the mountains. It is a major challenge before the fisheries scientists and managers to broaden their vision of fisheries. Fisheries' future depends upon the restoration of the degraded catchments (including floodplain habitats) of the rivers and ensuring certain amounts of flow so as to stimulate the natural flow regimes. Culture fisheries cannot be a substitute to natural fisheries because they can neither conserve the biodiversity nor protect the aquatic environment.