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Kiranmayi DhenuvakondaICAR-Central Institute of
Fisheries Education of Yari,
Versova, Mumbai, Maharashtra,
India**Arpita Sharma**ICAR-Central Institute of
Fisheries Education of Yari,
Versova, Mumbai, Maharashtra,
India

Mobile apps and internet of things (IoT): A promising future for Indian fisheries and aquaculture sector

Kiranmayi Dhenuvakonda and Arpita Sharma

Abstract

Empirical analysis of Indian mobile apps and IoTs in fisheries sector was performed using virtual information where features, downloads, ratings, space, year of publication were recorded. Total of 30 Indian mobile apps out of which, 12 were related to aquaculture whereas 9 each for marine fisheries and marketing were recorded. First app Aqua Brahma was published in 2015 and most recent Mathsya kiran was published in 2019. Daily Fish India had highest (1, 00,000+) downloads. Fish disease advisory, Sagar vani developed in 2018 had 500+ downloads each and Mathsya Kiran had highest rating i.e., 5/5. Most apps (17) had ratings between 4 to 5. Correlations showed that app size and ratings did not affect downloads. Government organisations have developed 15 apps. Three companies Eruvaka technologies, cFog, Aquaconnect are developing fish farm IoT systems so future looks promising. Study recommends capacity development of fisheries professionals in Artificial Intelligence (AI), mobile apps and IoTs.

Keywords: Mobile apps, internet of things, fisheries, aquaculture

Introduction

Fisheries and aquaculture are one of the fastest-growing subsectors of agriculture. It plays an important role in meeting out the food and nutritional security of the growing population. The sector makes crucial contributions to global food production and prosperity. In the past five decades, the global supply of fish for human consumption has outpaced population growth. Amongst all the countries, India ranks second in aquaculture production and second in total fish production. During the financial year 2017-18, the total fish production in India is estimated at 12.61 Million Metric tonnes. Fish production has increased from 5.66 Million Metric tonnes in 2000-01 to 12.61 Million Metric tonnes in 2017-18 (DAHDF annual report 2019) ^[1].

Ministry of Fisheries, Animal Husbandry, and Dairying is a newly formed ministry in India. It was formed in May 2019. The Government is working towards 'blue revolution' by developing India's fisheries and aquaculture. In the 2020 budget it has been announced that fish production is to be raised to 200 lakh tonnes by the year 2022. As per National Fisheries Development Board (NFDB), the future development of aquaculture depends on the adoption of new and innovative production technologies, management and utilization of less utilized water resources and proper market tie-ups.

For achieving the Blue Revolution (Neel Kranti Mission) and making fisheries a modern world-class industry, the need is to embrace new technologies like blockchain, AI and IoT and mobile apps. These technologies can play an important role in ushering the blue revolution. Amongst the new technologies, the mobile app and IoT industry are growing on a daily basis. The number of mobile apps in the market is increasing and is a big source of revenue generation. Mobile apps can help in the dissemination of the required information in the right form and at the right time. According to the GOI report (2019) ^[2] of Digital India-Technology to Transform a Connection Nation, India is one of the largest and fastest-growing markets for digital consumers, with 560 million internet subscribers in 2018, second only to China. Indian mobile data users consume 8.3 gigabits (GB) of data each month on average, compared with 5.5 GB for mobile users in China and 8-8.5 GB in the advanced digital economy of South Korea. Indians have 1.2 billion mobile phone subscriptions and downloaded more apps i.e., 12.3 billion in 2018 than residents of any other country except China. India is digitizing faster than any other country and over 40 percent of the populace has an internet subscription.

Corresponding Author:**Arpita Sharma**ICAR-Central Institute of
Fisheries Education of Yari,
Versova, Mumbai, Maharashtra,
India

The IoT is about connecting everyday things embedded with electronics, software, and sensors to the internet enabling them to collect and exchange data. Cisco (2018)^[3]. By 2025 it is expected that 75.44 billion devices will be part of IoT. Statista (2019)^[4]. IoT applications are available in every industry for Smart Homes, Wearables, Connected Cars, Industrial Internet, Smart Cities, Agriculture, Smart Retail, and Smart grids, Healthcare, Poultry and Farming. IoT Analytics (2019)^[5].

One of the benefits that modern technologies provide is that it promotes efficient resource utilization, minimizes human efforts in many life aspects. Mallon (2019)^[6]. There is a high potential for IoT in fisheries and aquaculture and fishers/farmers can have an edge in a competitive market. In India's new budget 2020 tax benefits have been announced for startups in the AI, deep technologies, ML and big data.

Even though there is an increase in the digital technologies and number of mobile phone and internet users, few studies have been attempted in this area like Kiranmayi et.al. (2019)^[5] have studied that usage of mobile apps by fish farmers of Telangana and found that farmers are not aware of apps related to fisheries. In the field of patents in fisheries, there are few studies like Ninan S. and Sharma (2006)^[7], Sharma (2020)^[8]. But in the field of mobile apps, there are a handful of studies like Amrita and Kumar (2016)^[9] and Sharma and Kiranmayi (2019)^[10] who documented mobile apps in the sector. Sharma and Kiranmayi (2020)^[11] have highlighted the importance of mobile apps and IoTs. Kiranmayi and Sharma (2019)^[12] have also reported about Progressive Web Apps (PWA's). Sharma and Kiranmayi (2019)^[13] have reported about the smart and sustainable aqua farming and reported about IoTs.

Considering the importance of mobile apps and IoTs, this study has been done with an objective of presenting an empirical analysis of Indian mobile apps and IoTs in the fisheries and aquaculture sector.

Materials and Methods

Virtual information was used in the ambit of compiling different types of mobile apps in the sector as explained by Sharma and Kiranmayi (2019)^[10] as in non-probabilistic samples it can increase the sample size and its representativeness. To adopt the virtual information, keyword typology method was used and search was done from google and google play store for android apps. Key words were 'mobile apps in fisheries/aquaculture', 'apps for fisher/s/men/women', 'mobile apps by fisher/s/men/women'. Mobile app store was searched using the key words fisheries apps/aquaculture apps and listings on related apps. To get information about the IoTs search was done from google using the key words IoTs in fisheries/aquaculture, IoTs for fish farm/ shrimp farm monitoring. A different type of snowball sampling method called as Virtual Product Snowball Sampling (VPSS) was used in this study. Sharma (2018)^[14] When search for apps was done on the internet or mobile app store and visit product page, the widget of the products usually bought together and customers also bought was also visited. This is done through data mining algorithms, produces a memory graph and is called as Art of Affinity Analysis or Market Basket Analysis. Usually this is used by customers and retailers but in this study this was used as a snowball method where one app leads to other and so on. As per Fabiola and Ignasi (2012)^[15], when social networks are used, then this technique is called virtual snowball sampling.

However, in this study it was not the use of social networks. The method used in this study is thus called as Virtual Product Snowball Sampling. Accordingly, relevant apps were recorded. During the search it was seen that there were some apps for meat delivery which included fish also. Since they were not exclusively for fish, they were included. The list of collected apps along with the features were presented to 16 fisheries professionals so as to make them aware as well as collect information from them if any app which is used has been missed in this search. In this way information collected was also validated. Ratings and downloads are very important when it comes to mobile apps. Recent mobile consumer survey by Deloitte (2019)^[16] reveal that nearly half of all mobile app users identified browsing the app store charts and search results (the placement on either of which depends on rankings) as a preferred method for finding new apps in the app stores. Better rankings mean more downloads and easier discovery.

It is to be noted that currently it is not possible to find the exact number of downloads on the play store, as google does not provide this information. It provides information on round off basis starting from 100+ and more. Gabriel (2017)^[17].

In addition, the amount of space required to install the app also is important. So from the app store downloads, ratings, space, year of publication were recorded for each app. Correlation between ratings and downloads and downloads and space was computed using the formula.

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}}$$

Results and Discussion

A total of 30 mobile apps could be found out of which, 12 are related to aquaculture, 9 each for marine fisheries and marketing.

A study by Sharma and Kiranmayi, 2019^[10] has reported that apps related to marine fisheries were maximum. Amrita and Karthickumar, 2016^[18] in their study have also reported the need of mobile apps.

Apps related to aquaculture provide information on market prices, news and events related to aquaculture, disease advisory, culture information, inputs and machinery.

Apps related to marine fisheries provide information on potential fishing zone (PFZ), ocean state forecast, wind speed, wave heights, disaster alerts, Global positioning system (GPS), tsunami warning, search and rescue information.

Apps related to marketing provide home delivery of marine/fresh water fishes, shrimps, crabs, lobsters etc. in raw and also dressed form.

The total number of apps in fisheries and aquaculture is given below in table 1.

Table 1: Mobile apps in fisheries and aquaculture

| Field | Number of mobile apps | Percentage |
|------------------|-----------------------|------------|
| Aquaculture | 12 | 40.00 |
| Marine fisheries | 9 | 30.00 |
| Marketing | 9 | 30.00 |
| Total | 30 | |

A total of 12 apps were found from the field of aquaculture. These are explained in brief as follows.

1. Aqua Brahma: App Developed by Mile Deep Works Pvt. Ltd. in 2015. It helps the farmers to stay connected with

suppliers and hatcheries and get educated day by day with news, market indicators and material trade. App supports Telugu, Hindi, English, Marathi, Bengali, Kannada, Tamil, Malayalam, Gujarati.

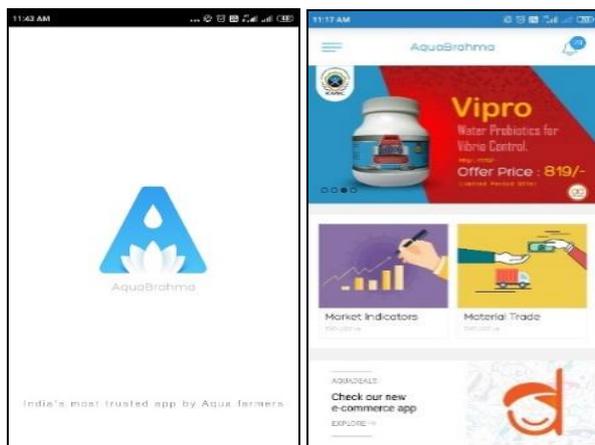


Fig 1: Screenshots of Aqua Brahma App

2. Mathsya Kiran: The app is developed in 2019 under Masters research programme undertaken at ICAR-CIFE. It is a gateway to information on Inland fisheries in text and attractive image format.

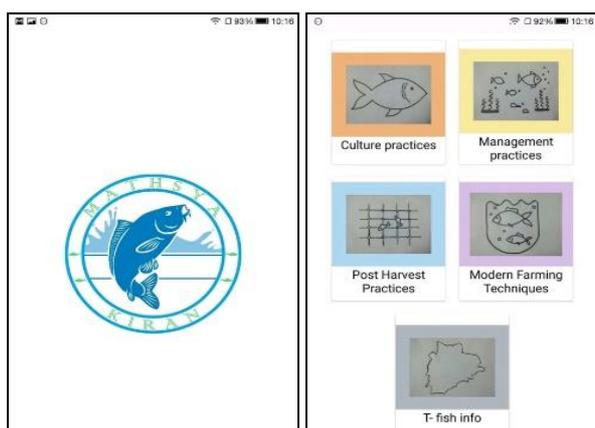


Fig 2: Screenshots of Mathsya Kiran App

3. Aqua Farmer App: App developed by Aqua App in 2018. The app helps farmers get the latest market prices, information about best practices, news, events, videos related to aquaculture. Available in English, Telugu and Hindi languages.

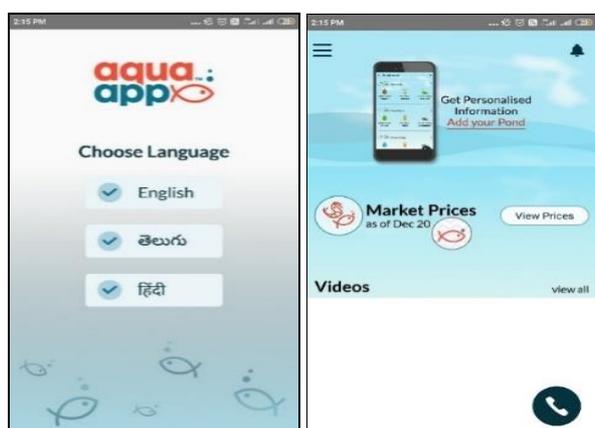


Fig 3: Screenshots of Aqua App

4. Aquall App: App developed by Aquall Foods and Products Pvt. Ltd in 2016. An e-commerce platform for farmers which provides a one-stop place for seeds, feeds, chemicals, aerators as well as hardware products. Available in Telugu and English.

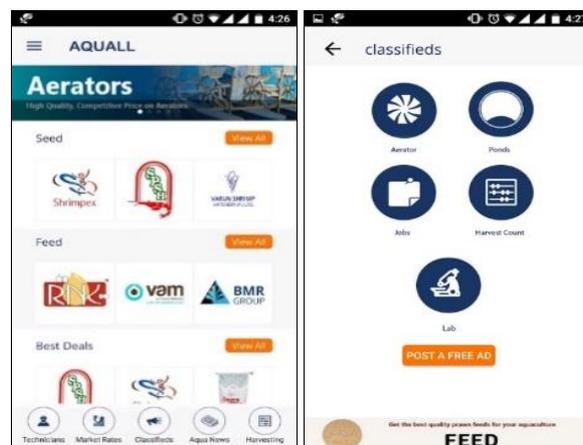


Fig 4: Screenshots of Aquall App

5. Fish Disease advisory: App is developed by ICAR-CIFRI in 2018. The app gives information about diseases, causative agents and remedial measures in English.



Fig 5: Screenshots of Fish Disease Advisory App

6. Fish Names: App is developed by Drapes in 2017. It helps to identify over 120 and 72 species of sea and river fish respectively offline in image and text format. App is available in English language.



Fig 6: Screenshots of Fish Names App

7. India Aqua: App is developed by ICAR-CIFA in 2019. The app is an Information gateway for Indian aquaculture which has technology modules for different fishes, the database of stakeholders, FAQs, updates, discussion forum. App supports Hindi, English, Odia languages.

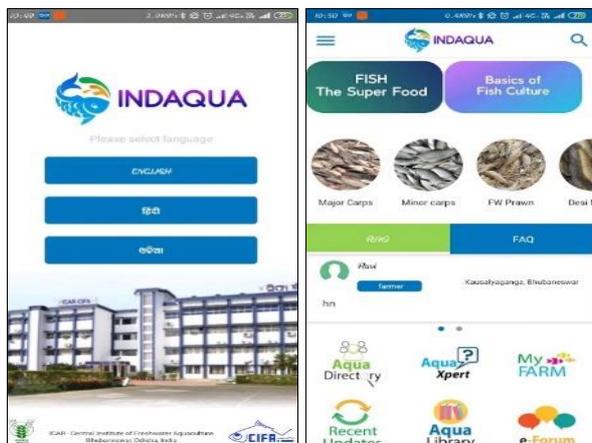


Fig 7: Screenshots of IndAqua App

8. Vanamei Shrimp app: ICAR-CIBA has developed the app in 2017. It provides technical information on Pacific white shrimp farming like best management practices, input calculators, disease diagnosis, shrimp farm risk assessment, government regulations and FAQ's in English.



Fig 8: Screenshots of Vanamei Shrimp App

9. Pescare: It is developed by Budding developers in 2017. It is available in English language and helps one to diagnose and control the diseases in fish and shrimp.

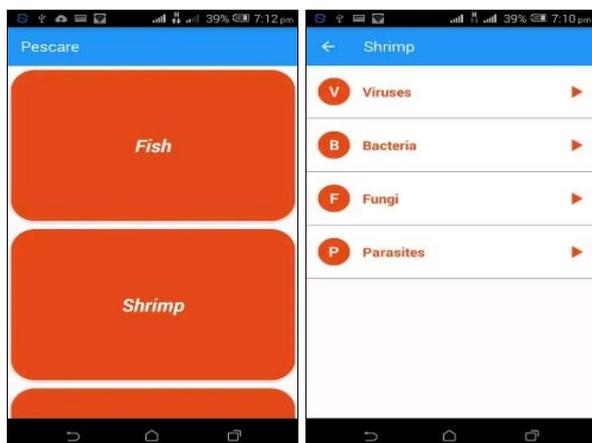


Fig 9: Screenshots of Pescare App

10. mJhinga: ICAR- CIFE developed the app in 2019. It provides information on setting up new ponds, growing healthy shrimp crop, market prices. It has a digital notebook to record daily inputs, harvests and expenses.



Fig 10: Screenshots of mJhinga App

11. CIFT Lab Test: The app is developed in 2019 by ICAR-CIFT and is intended for providing information related to different types of sample testing and analysis of various fish and fish based products, fishing gear materials, packaging materials, microbiological parameters, quality parameters of ice and water samples etc.



Fig 11: Screenshots of CIFT Lab Test App

12. CIFT Training: ICAR- CIFT has developed the app in 2019 that provides a complete package of information on ICAR- CIFT training programmes. The app is highly useful for fisheries students, researchers, industry personnel, state extension personnel and other stakeholders to access the online information regarding different types of training programmes organized by CIFT.

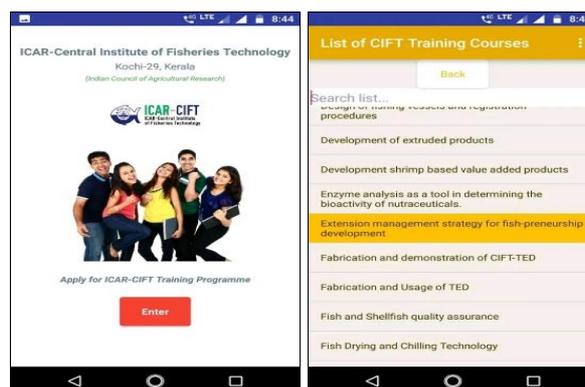


Fig 12: Screenshots of CIFT Training App

More information about the apps in the field of aquaculture is presented in table 2.

Table 2: Mobile apps related to aquaculture

| S. No | Name of the app | Developer | Rating (out of 5★) | Size in mb | Downloads | Released on |
|-------|-----------------------|------------------------------------|--------------------|------------|-----------|-------------|
| 1 | Aqua Brahma | Mile Deep Works Pvt. Ltd. | 4.2 | 4.80 | 10000+ | 21 Feb 2015 |
| 2 | Aqua Farmer App | Aqua App | 2.8 | 22.63 | 1000+ | 12 Feb 2018 |
| 3 | Aquall App Marketing | Aquall Foods and Products Pvt. Ltd | 4.6 | 7.91 | 10000+ | 9 Aug 2016 |
| 4 | Fish Disease advisory | ICAR-CIFRI | 5.0 | 5.23 | 500+ | 22 Oct 2018 |
| 5 | Fish Names | Leh | 3.2 | 12.34 | 5000 | 4 Dec 2017 |
| 6 | Ind Aqua | ICAR-CIFA | - | 11.68 | 500+ | 5 Mar 2019 |
| 7 | Vanamei Shrimp app | ICAR- CIBA | 4.5 | 34.62 | 10000+ | 4 Apr 2017 |
| 8 | Pescare | Budding Developers | 4.9 | 1.6 | 100+ | 8 Nov 2017 |
| 9 | Mjhinga | ICAR- CIFE | - | 18 | 500+ | 28 Sep 2019 |
| 10 | Mathsya Kiran | Kiranmayi <i>et al.</i> | 5 | 25 | 100+ | 11 Nov 2019 |
| 11 | CIFT Lab Test | ICAR- CIFT | - | 7.11 | 100+ | 6 Jun 2019 |
| 12 | CIF Training | ICAR- CIFT | - | 7.5 | 100+ | 7 Jun 2019 |

It is clear from table 2 and the discussion that amongst that amongst aquaculture related apps, Aquabrahma, Aquall app, and Vanamei Shrimp app have the highest number of downloads i.e. 10000+. The ratings of these apps are above 4. It was seen that Fish disease advisory and Mathsya Kiran have the highest rating i.e. 5.

Aquaculture is a growing field. It is expected that India is likely to achieve record production of farmed shrimps this financial year contrary to the earlier forecast of a drop in output. Looking at the low stock, poor prices and diseases in the first half of the fiscal, the industry had predicted 10-20% slump. But exports picked later and India with 27% share is driving shrimp exports. China has become the second largest buyer with 25% share after the US (42%). In 2020 the growth of online and supermarket shopping will lead to continued growth. This is an area where it is expected that new technologies like IoT etc will be introduced.

With reference to marine fisheries, it was found that there were 9 apps. Information about the same is presented as follows.

1. FFMA (Fisher Friend Mobile Application): Developed by M.S. Swami Nathan Research Foundation in 2016. FFMA is a single window solution to address knowledge requirements such as PFZ, Ocean state forecast, Danger zone alerts, Disaster alerts, SOS (Save our Soul). It is a multilingual app developed in regional languages of coastal India such as Tamil, Malayalam, Odia, Bangla, Kannada, Marathi and Gujarati apart from common English version



Fig 13: Screenshots of FFMA App

2. INCOIS: App is developed by INCOIS in 2016. This app

disseminates ocean information services such as PFZ, TUNA PFZ for benefit of Fishermen Community of India in English.



Fig 14: Screenshots of INCOIS App

3. mKrishi@fisheries: App developed by Tata consultancy services (TCS) Innovation Lab- Mumbai, in collaboration with ICAR- Central Marine Fisheries Research Institute and Indian National Centre for Ocean Information Services (INCOIS) in 2017. The app is for the potential fishing zone, wind speed, and direction, wave heights. App is available in Telugu, English, Tamil, Malayalam, Odia, Bangla, Kannada, Marathi and Gujarati.



Fig 15: Screenshots of mKrishi@fisheries App

4. Machli: App is developed by Reliance Foundation Information Services in 2019. The app provides Ocean state forecast for Indian Fishermen at a distance of 50 km from each fish landing site spread across all the Indian coastline. Available in Telugu, Kannada, Marathi, Hindi, English, Gujarati, Malayalam and Tamil.

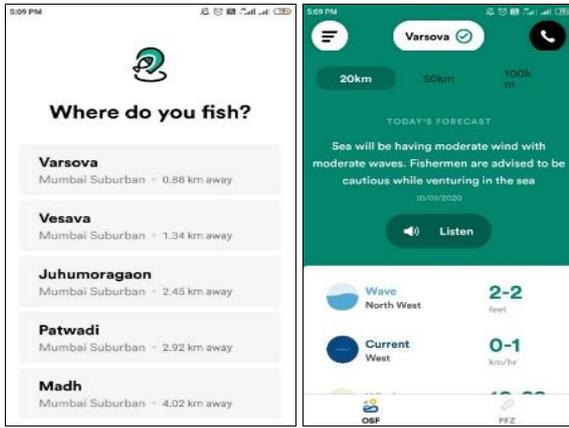


Fig 16: Screenshots of Machli App

5. Odaku: App is developed by Odaku Online Services Pvt. Ltd. The app is an online service platform for fishermen in India. It provides tools and technologies that help fishermen on their daily activities. It includes features like inbuilt GPS, solves international borders issue and also local borders defined by the state level, ability to share trawling tracks, buy/sell used boats etc. Available in Telugu, Kannada, Marathi, Hindi, English, Gujarati, Malayalam and Tamil.

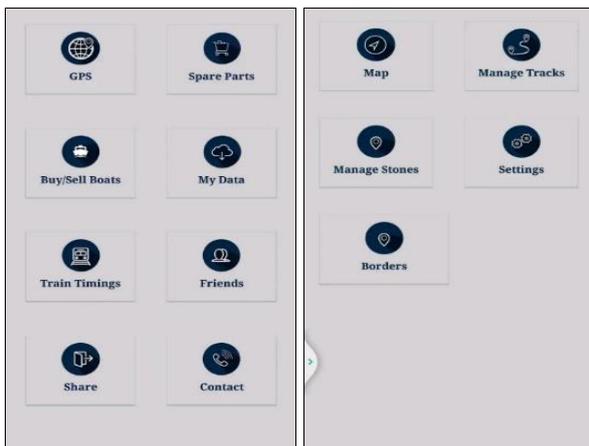


Fig 17: Screenshots of Odaku App

6. PFZ- Advisory: Developed by Mobile Seva in 2015. A multilingual app used for disseminating potential fishing zone advisories to fishermen along coastal areas of India. 9 Sep 2015. Available in Urdu, Telugu, Kannada, Marathi, Hindi, English, Gujarati, Malayalam and Tamil.

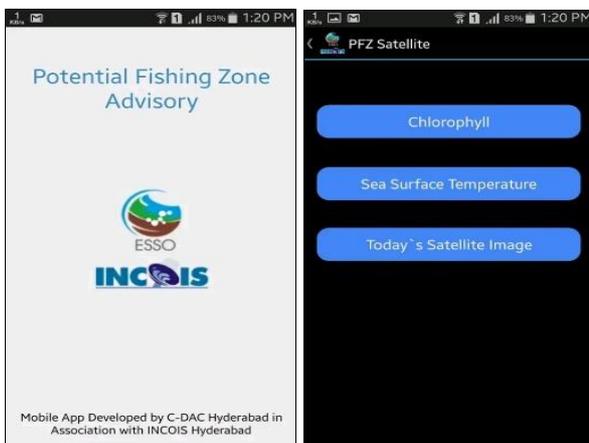


Fig 18: Screenshots of PFZ Advisory App

7. SARAT (Search and Rescue Aid Tool): App is developed by INCOIS in 2017. It is used for conducting research and rescue operations in the sea. Available in Telugu, Kannada, Marathi, Hindi, English, Gujarati, Bangla, Oriya, Malayalam and Tamil.



Fig 19: Screenshots of SARAT App

8. Sagar Vani: INCOIS Developed the app in 2017. It provides information on PFZ, Ocean state forecast, High wave alerts, and Tsunami early warnings in English.

9. Sagara: App developed by NIC e Gov Mobile Apps in 2018. It is a digital initiative by the Department of Fisheries and NIC Kerala for monitoring fishing crafts and crews going for the fishing operation. App is available in English, Kannada, Malayalam, Tamil.



Fig 20: Screenshots of Sagara App

More information about the apps in the field of marine fisheries is presented in table 3.

Table 3: Mobile apps related to marine fisheries

| S. No. | Name of the app | Developer | Rating (out of 5★) | Size in mb | Downloads | Released on |
|--------|---|--|--------------------|------------|-----------|-------------|
| 1 | FFMA (Fisher Friend Mobile Application) | M.S. Swami nathan Research Foundation | 4.6 | 8.2 | 10,000+ | 29 Dec 2016 |
| 2 | INCOIS | INCOIS | 3.5 | 3.34 | 1000+ | 15 Feb 2016 |
| 3 | mKrishi@fisheries | ICAR-CMFRI, TCS | 4.4 | 5.6 | 1000+ | 8 Mar 2017 |
| 4 | Machli | Reliance Foundation Information Services | | 8.97 | 5000+ | 5 Aug 2019 |
| 5 | Odaku | Odaku Online Services Pvt. Ltd | 4.9 | 8.39 | 1000+ | 1 Nov 2015 |
| 6 | PFZ- Advisory | Mobile Seva | 3.7 | 1.42 | 100+ | 9 Sep 2015 |
| 7 | SARAT (Search and Rescue Aid Tool) | INCOIS | 4.4 | 19.01 | 1000+ | 14 Jul 2017 |
| 8 | Sagar Vani | INCOIS | 5 | 5.37 | 500+ | 28 Jul 2017 |
| 9 | Sagara | NIC eGov Mobile Apps | 4.7 | 2.71 | 5000+ | 25 Feb 2018 |

It is clear from table 3 and the discussion that amongst apps related to marine fisheries, Fisher Friend Mobile Application (FFMA) has the highest number downloads i.e. 10000+. SagarVani app has the highest rating i.e. 5 followed by Odaku and Sagara i.e. 4.9 and 4.7 respectively. However, all apps have ratings above 3.

It was found that apps related to fish marketing were also 9 in number. Information about them is presented as follows.

1. Aqua Pulse: App is developed by Pinnacle Soft in 2017. Shrimp purchase mobile app and acts as a bridge between companies and sellers. Available in English language.

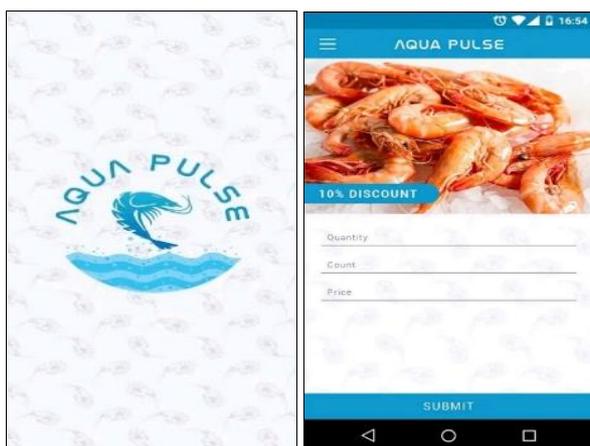


Fig 21: Screenshots of Aquapulse App

2. Daily fish India: Developed by Baby Marine Enterprise in 2016. It is an online seafood store. Daily Fish is available in Ernakulam and Trivandrum.

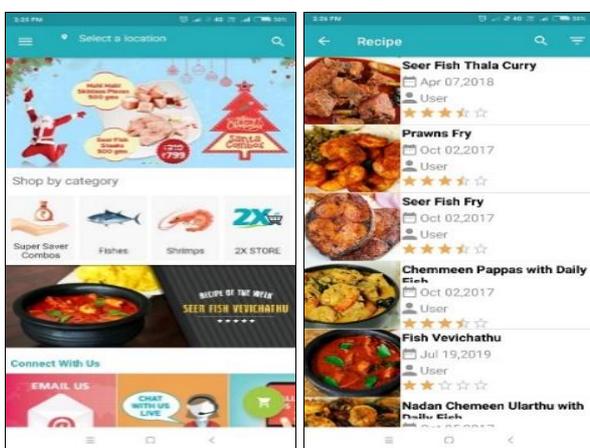


Fig 22: Screenshots of Daily Fish India App

3. Healthy Fish: Developed by Healthy Fish in 2016. It is an online marine fish, farm freshwater fish, Dry fish, Crabs, Shrimps, Lobsters delivery app.

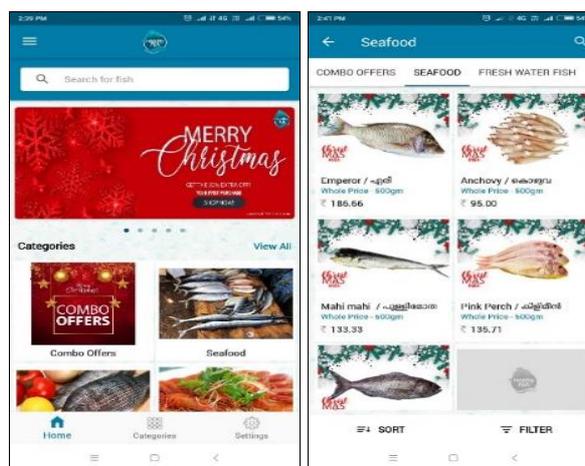


Fig 23: Screenshots of Healthy Fish App

4. Marine fish sales: App developed by Zacharia PU and ICAR- CMFRI in 2019. The app facilitates direct sales between fisherfolk and customers.

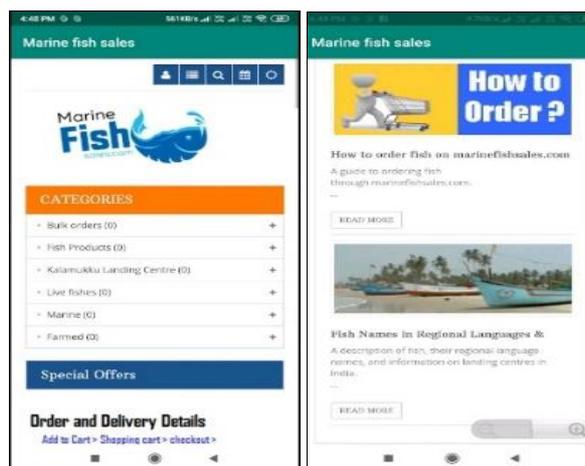


Fig 24: Screenshots of Marine fish sales App

5. Matha Fresh Fish: App is developed by Matha fresh fish in 2018. It is an online seafood store in Kerala.

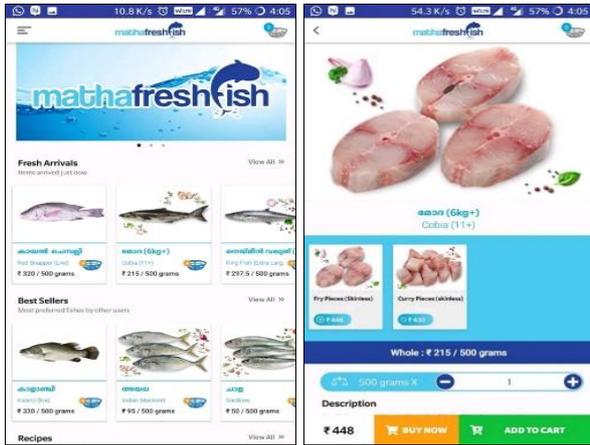


Fig 25: Screenshots of Matha fresh fish app



Fig 27: Screenshots of Smart fish App

6. **Nallameen.com:** Infametech Solutions Pvt. Ltd developed the app in 2017. The app delivers fresh fish from the daily catch in and around Kochi.



Fig 26: Screenshots of Nallameen App

8. **Fresh Fish Cart:** Developed by Astin Soft pvt ltd, in 2017. It delivers all type of fresh fish and sea foods.

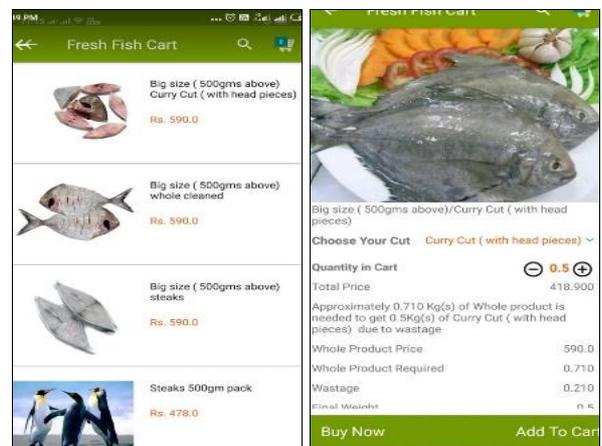


Fig 28: Screenshots of Fresh fish cart App

7. **Smart fish:** Developed by State Department of Fisheries, West Bengal in 2018. It is an online fish delivery app.

9. **Aqua Deals:** Mile Deep Works Pvt Ltd. Developed Aqua Deals App which is a farmers market place app which sells feed, machines, health care products etc. in 9 regional languages.

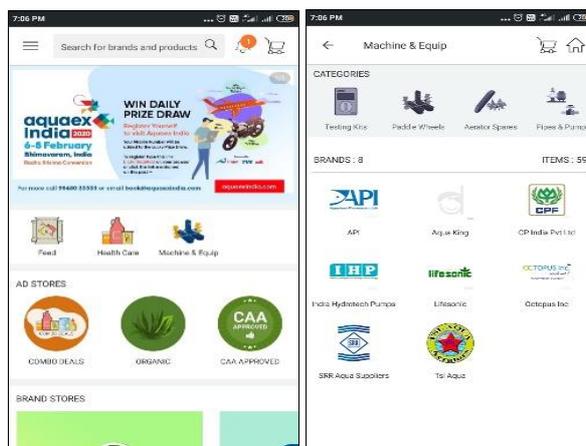


Fig 29: Screenshots of Aqua Deals App

Table 4 presents the information about the mobile apps related to marketing.

Table 4: Mobile apps related to marketing

| S. No | Name of the app | Developer | Rating (out of 5★) | Size of the app | Downloads | Last updated |
|-------|-------------------|--------------------------------------|--------------------|-----------------|-----------|--------------|
| 1 | Aqua Pulse | Pinnacle Soft | 4.2 | 4.52 | 100+ | 1 Aug 2017 |
| 2 | Daily fish India | Baby Marine Enterprise | 3.9 | 8.87 | 1,00,000+ | 9 Feb 2016 |
| 3 | Healthy Fish | Healthy Fish | 4.6 | 5.06 | 1000+ | 6 Dec 2016 |
| 4 | Marine fish sales | ICAR- CMFRI, Zacharia PU | | 2.07 | 10+ | 1 Feb 2019 |
| 5 | Matha Fresh Fish | Matha fresh fish | 4.8 | 10.75 | 1000+ | 29 Mar 2018 |
| 6 | Nallameen.com | Infametech Solutions Pvt. Ltd | 4.2 | 6.97 | 1000+ | 7 Oct 2017 |
| 7 | Smart fish | Department of Fisheries, West Bengal | 3 | 5.09 | 10000+ | 4 Jan 2018 |
| 8 | Fresh Fish Cart | Astin Soft Pvt Ltd | 4.3 | 5.4 | 5000+ | 14 Jun 2017 |
| 9. | Aqua Deals | Mile Deep Works Pvt Ltd | 4.3 | | 10000+ | 12 Feb 2017 |

It is clear from table 4 and the discussion that marketing related apps are mostly for online fish delivery. Amongst these, Daily Fish India has the highest number of downloads i.e. 1, 00,000+ followed by Smart fish and Aqua Deals with 10,000+. Matha fresh fish has the highest rating i.e. 4.8 followed by healthy fish i.e. 4.6.

According to Tian *et al.*, (2015) ^[19] the factors potentially affecting app ratings are size of app, marketing efforts, category of app, requirements on users, complexity of user interface. An attempt was made to find the correlation between downloads/rating and space/downloads. The findings reveal that there was weak correlation (-0.15) between customer rating and popularity (rank of app downloads) and also space and downloads (-0.01). However, study conducted by Finkelstein *et al.*, (2017) ^[20] there are strong correlations between customer rating and number of downloads.

Scatter plot diagrams were attempted to see how much one variable is affected by another i.e., between app ratings and downloads as well as app size and downloads are given in figure 1 and 2 respectively.

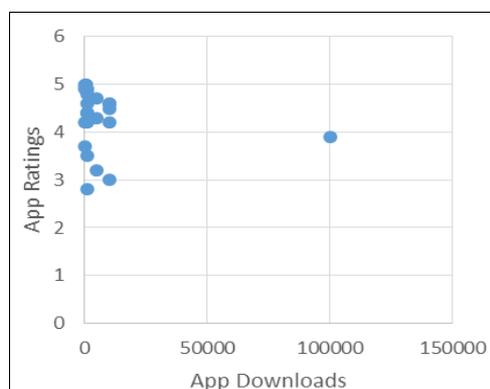


Fig 30: Correlation between app ratings.

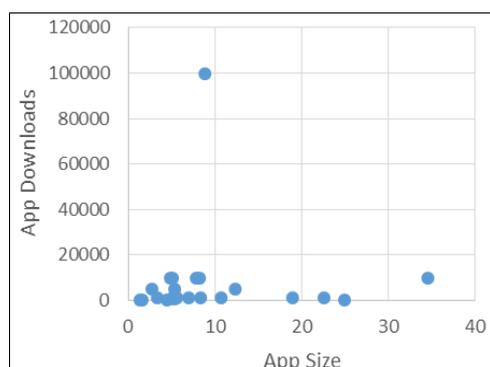


Fig 31: Correlation between App size and downloads.

It is clear from the figures that the app size and ratings are not affecting number of downloads. In addition to this, it could be established that on 21st Feb, 2015 first mobile app Aqua Brahma was developed. On 11 Nov 2019, the most recent app Mathsya kiran has been developed. But it cannot be said that number of apps being developed are increasing every year as a total of 3 apps were developed in 2015 and 5 apps were developed in 2016. In 2017 maximum number of apps i.e. 10 were developed. However, in 2018 and 2019 again 5 each were developed.

Amongst the apps which has highest downloads, Daily Fish India has 1, 00,000+ downloads. This is an app which is a fish market app where orders can be placed and home delivery of fishes/shrimps is made. Rating of this app is 3.9/5

The 3 apps Fish disease advisory, Sagar vani and Mathsya Kiran have highest rating i.e., 5/5. Fish disease advisory and Sagar vani app developed in 2018 has 500+ downloads, Mathsya Kiran which is most recently developed in 2019 has 100+ downloads.

It was also found that all mobile apps are rated above 2.5/5. Most apps i.e., 17 had ratings between 4 to 5. This was followed by 5 apps which had ratings between 3 to 4. Only 1 app had ratings between 2 to 3. It is clear that ratings the users are providing good ratings to these mobile apps. All apps were found to be free of cost.

It was also found that Government organisations have developed 15 of these mobile apps out of which ICAR institutes have developed 9. Private organisations have developed 14 apps out of which one is under Corporate Social Responsibility. One app has been developed by non profit trust.

Three Indian companies were found involved in IoT. Eruvaka Technologies from Andhra Pradesh established in 2012 is involved in building IoT system that help measure different water parameters that are crucial for the growth and survival of shrimps in an aquaculture pond. Data collected from the sensors is uploaded on cloud and then transmitted to individual customers through an Android app installed in their phones. Information collected includes oxygen levels, temperature and pH range in the pond. Besides accessing information through the app, it can also be transmitted via SMS or Voice call. cFog, from Andhra Pradesh established in 2017 is involved in solar-powered systems that can automate aerators and feeders across multiple ponds, monitors with parameters of dissolved oxygen, pH, ammonia and temperature. Aqua Connect from Tamil Nadu established in 2017 is a Chennai based start-up and has developed Farm MOJO, a farm advisor which uses machine learning to provide insights to the shrimp farmers to manage the pond water quality, feeding information, growth rate of the shrimp.

Conclusion

It is known that fisheries and aquaculture is one of the fastest growing subsectors of agriculture. The sector has been given importance by the Government of India and now there is a Ministry of Fisheries, Animal Husbandry and Dairying. This is the time that this sector should take advantage of the Government's focus on Digital India. By embracing new technologies like block chain, AI, IoT and mobile apps the sector can grow more. There is immense scope of all these new technologies in the sector. There is a need to have specific mobile apps based on the users and different stakeholders like fishermen, fisher women, fish farmers, processors, fish workers, consumers and more. Through this study it has been revealed that there are specific mobile apps in this field and some have good ratings and downloads.

A total of 30 Indian mobile apps could be found out of which, 12 were related to aquaculture whereas 9 each for marine fisheries and marketing. First mobile app Aqua Brahma was published in 2015 and the most recent app Mathsya kiran has been published in 2019. Amongst the apps which has highest downloads, Daily Fish India has 1, 00,000+ downloads. With reference to ratings, three apps Fish disease advisory, Sagar vani developed in 2018 with 500+ downloads each and Mathsya Kiran which is a recently developed have highest rating i.e., 5/5. Most apps i.e., 17 had ratings between 4 to 5 and all mobile apps had a rating above 2.5/5. Size/space of the app in MB ranged from 1.4 to 34.62 and all apps were available for free.

However, weak correlations existed between customer rating and app downloads and also between space and downloads suggesting that app size and ratings are not affecting number of downloads. It was also seen that Government organisations have developed 15 of these mobile apps out of which ICAR institutes have developed 9. Private organisations have developed 14 apps out of which one is under Corporate Social Responsibility. One app has been developed by non-profit trust.

With reference to IoTs it was found that there are 3 companies Eruvaka technologies, c Fog, Aqua connect which are involved in developing fish farm monitoring IoTs systems especially for parameters like pH, Dissolved oxygen, temperature, ammonia, automatic feed distribution etc. It is clear from the study that the journey of mobile apps related to fisheries sector is relatively new and started in 2015 and users have provided good ratings to the apps. IoT is a new area and the future looks promising. The study recommends capacity development of young fisheries professionals in the emerging information technology areas like AI, Blockchain, mobile apps, IoTs etc. for which Innovative advantage can be taken from available online courses and adoption of new pedagogical models as reported by Sharma *et al.* (2019) ^[21].

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