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An Assessment of M-Commerce Adoption Amongst Women Fish Vendors in Coastal India Using System Dynamics Approach

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Abstract

The digital revolution in India has played a significant role transforming traditional organizations through adoption of mobile commerce (m-commerce) and transforming the way they do business. For the successful implementation of m-commerce, a thorough understanding of the stakeholder perspectives is always important. Hence, to summarize the issues and perspectives of the women fish vendors (WFVs) and to study the effect of crucial parameters on the implementation success of m-commerce a system dynamics (SD) approach was used. SD methodology is used to develop a simulation model to understand the m-commerce adoption rate amongst WFVs considering multiple scenarios. The research findings reveal that, word of mouth (WOM) and user experience plays a major role towards the adoption of m-commerce. However, the WFVs were sceptical about the capabilities of m-commerce and weren't well equipped with infrastructure. This approach will enable the academicians and social entrepreneurs to formulate strategies to empower WFVs by using technology. Also, it opens a new area of simulation-based policy modelling in the fisheries retail sector.

Keywords

Fisheries, m-commerce, participatory system mapping, system dynamics, policy making.

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Introduction

Indian fisheries with 8129 km coastline and aquaculture are an important sector providing nutritional security to the food basket and engaging about fourteen million people in different activities. This sector contributes to 1.1% of India's GDP and 5.15 % of the agricultural GDP of India. Currently India stands the third position in fisheries and second in Aquaculture. Karnataka State in the southern part of India has 320 Km long coastline comprising of three districts Dakshina Kannada, Udupi and Uttara Kannada collectively called as coastal Karnataka. There are about 9.61 lakh people involved in fishing activity in the state who are engaged with different fisheries exercises. Different communities live on fishing, fish trading, sellers or act as middlemen to other giants of this industry. There are some specific communities involved in fishing activity in coastal Karnataka. Mogaveera community is predominant in Dakshina Kannada and Udupi district where as Kurmi community are the majority in Uttara Kannada district when it comes to fish related activities. As it is community rooted activity, there is trust amongst the people and word of mouth (WOM) plays a vital role in any adoption or rejection of the new process. Men in the community associated with catching of fish whereas woman are employed in drying and selling of fish. These communities largely depend on woman in monsoon season (June – August) for their daily needs as catching fish in deep sea is banned at this season.

With the raise of technology driven super markets and lack of infrastructure and necessary technology awareness, it is affecting the business of several woman fish vendors (WFVs) in this part of the state (Gunakar and Bhatta, 2016). Digital illiteracy/ adoption among WFV's is one among a significant cause for their marginalisation and cause a drop in their commerce (Aswathy, Sathiadhas and Narayanakumar, 2011). Prabhu, Kamath and Joshi (2019) explored the socio-economic

perspective of WFV's on their current digital adoption, their readiness to move towards and their willingness to go digital in their business. This study reveals that WFVs make use of the traditional method to sell the fish. Even though most of the WFVs own a feature phone (no internet, only calling and SMS service), their current adoption of m-commerce is in the nascent stage. It was encouraging to see most of the WFVs have a bank account (89%), Aadhaar card (Unique Identification number given by Govt. of India) (100%) and mobile phone (93%), which provides an infrastructural base for building m-commerce solutions. It was found, WFVs who are below 45 age and whose education is higher than 4th standard have shown significant interest in the adoption of m-commerce. Finally, it was observed that awareness about cashless economy amongst WFVs had positive attitude towards getting digitally trained and use m-commerce in their day to day business (Prabhu & Joshi, 2018).

System Dynamics

System Dynamics (SD) is a methodology proposed by Forrester (1961). SD is used in different systems where the processes are dynamically complex (Sterman, 2002). SD distinguishes itself from other simulation approached due to its ability to deal with non-linear behaviour of the dynamic systems (Morecroft & Heijden, 1992) and to describe any given system mathematically using qualitative or quantitative modes due to the inherent feedback structures. SD modelling comprises of following steps viz. problem identification, system conceptualisation, model formulation, simulation & validation, and policy analysis & improvement (Sushil, 1993).

Many studies have built SD models among fishers (Scheffran, BenDor and Hannon, 2006), shrimp commodity cycle (Arquitt, Honggang and Johnstone, 2005), management of specific fisheries (McGlade, 1989), strategic planning for fisher groups (Otto and Struben, 2004) and other fisher related models (Moxnes, 2000; Moxnes, 2005; Ruth and Lindholm, 2002).

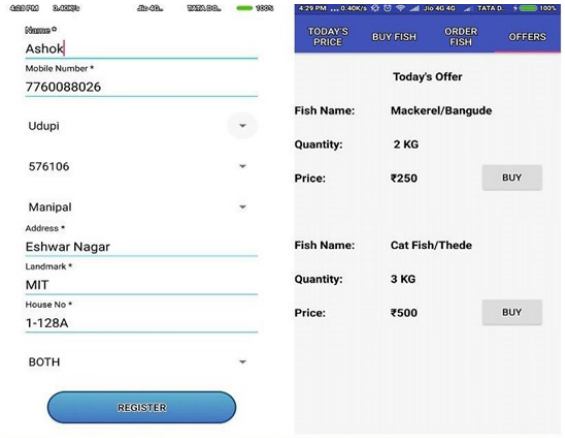
However, it is an interesting observation that there are limited literature, discussing the application of SD to understand the rate of technology adoption among WFVs. Hence, the study focuses on developing a SD model to analyse unorganized fish retail business and identify the determinants that would play major role in sustenance of the business.

Materials and methods

They study was conducted using quantitative approach using questionnaire and qualitative approach using participatory system model (PSM). The quantitative analysis gave a grounding into the current situation concerning the demographic details and the level of awareness about m-commerce (Prabhu and Joshi, 2018). Hence this paper focuses on the qualitative approach using PSM activity.

For the PSM activity, unlike other statistical techniques, the sample size in PSM is primarily dependent on the nature of the interaction, the complexity of the system being considered (Stave et al., 2017). There is, however, no literature to determine the appropriate participant size. However, researchers viz. (Malard et al., 2015; Sedlacko et al., 2012) have used numbers ranging between 8-10 in their research. The WFVs were chosen randomly using the lottery method. In the first round, seven respondents were selected, but they backed out due to the unwillingness to participate due to a trust deficit. The exercise was repeated, and another seven respondents were selected. This time they were approached through the officer of the fisheries department. The seven respondents agreed to be a part of the PSM activity, but only three turned up. Participants in the interviews were primarily academicians (2), fisherwomen (3), entrepreneurs (2), and customers (3). In total 10 participants were selected for the PSM activity.

In order to makes these participants aware of m-commerce, a mobile application named "m-Fish Market" was developed (see Figure 1 and Figure 2). The participants were made aware of the role of m-commerce to bridge the gap between consumers and sellers.



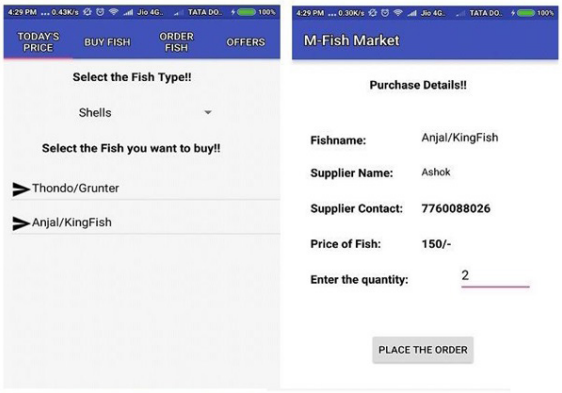
Source: Author

Figure 1: WFV interface of m-Fish market app.

The application was designed to work like an aggregator used primarily in hotel bookings (www.booking.com). The app prototype was developed on the Android platform. Both parties (WFVs and the customers) had to create an account by providing their details in the app.

On the client side of the app (Figure 2), the app could identify the different sellers in the area/ locality, the types of fishes available and the prices and seamlessly order them. Also, the pre-ordering facility was available. The app had the capabilities to get it integrated with m-banking facilities.

Also, going forward, it was thought that the app could also be connected to the wholesalers and the middlemen for getting information on the stock available with them and the daily prices. With additional services like intermediate delivery systems during the day by delivery boys, the stock availability at the WFV level could be ensured leading to high serviceability.



Source: Author

Figure 2: Customer interface of m-Fish market app.

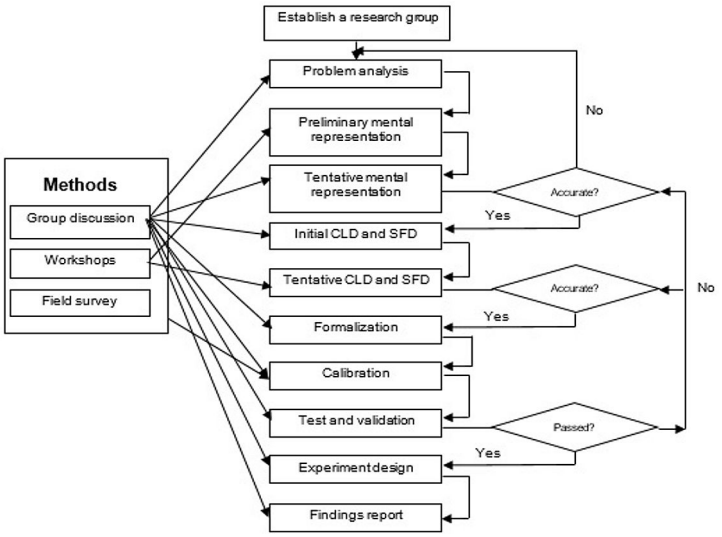
Participatory systems mapping activity

The participants were asked to classify the underlying issues on a day to day basis for the technology adoption (m-commerce) amongst different stakeholders of fishery industry. This was used to identify the essential gaps that exist in the system. These qualitative interviews enabled in identifying the significant issues and enabling factors for the adoption of m-commerce in their day to day business.

Further, a case study was conducted to analyse how WFV's business would progress under different scenarios of adopting m-Commerce in the day to day business. The study makes use of PSM framework (Wang & Cheong, 2005) to develop a reliable model. This framework was considered to be practical (see Figure 3) for building an SD model for fisheries. To develop the model, the study was conducted by combining several group process techniques like group discussion, brainstorming sessions, workshop and fieldwork.

The model uses several group process techniques to incorporate varied knowledge, which includes expert views, domain knowledge, systems thinking and SD. The PSM framework incorporates different stages of model building process proposed by (Streman, 2002). The stages include problem identification, framing hypothesis, building a simulation model, testing, and policy design and evaluation.

In the modelling stage, the PSM framework was used to develop a mental representation, identifying the variables (Annexure 1), a causal loop diagram (CLD) and a stock and flow diagram (SFD) through



Note: CLD = causal loop diagram; SFD = stock and flow diagram
Source: Wang and Cheong, 2005

Figure 3: The PSM framework

which a simulation model is developed. The CLD links variables that have a causal interpretation and the SFD represents the structure of a target system with denotations of rates and accumulations.

The model was tested for its causality as suggested by (Roy & Mohapatra, 1999), and robustness as proposed by (Barlas, 1996; Sterman, 2002). The simulation results were analyzed and dimensional consistency of each variable was tested. Vensim® 9.00 version software is used to develop the SD simulation model.

Result and discussion

Outcome of PSM Activity (see Table 1) are highlighted with the key issues and enabling factors of the stakeholders of fisheries sectors towards the adoption of m-commerce.

The model studies the effect of the enablers and barriers towards the adoption of the "m-Fish market app" amongst WFVs. The study simulated the effects of the above-mentioned parameters on the app users in the context of Udupi fish market.

Overall, the Udupi fish market houses 104 WFVs, this is identified as the variable market size. Amongst the 104 WFVs, there are 74 WFVs who have no access to smart phone which is a major factor for not adopting the app. Hence, it is considered 0.7 (74/104) as the factor for barriers of adoption. Effectiveness of WOM by their peers is considered as 0.3, 0.6, and 0.9 respectively representing low, medium and high levels of would be WOM adoption. Simulation start with introducing the app to 2 WFVs, which is reflected in the seed customers. Our assumption is that since it is an easily replicable product, there exists a scope for competitors to bring in new applications. Based on experience, it is assumed 12 weeks as the minimum duration which the people remain loyal to the application before switching over.

The study simulates 3 cases:

Case 1: Varying WOM effectiveness with same barriers of adoption: This scenario represents that the fisheries federation only encourages the WFVs to adopt "m-Fish market" app. But it doesn't provide adequate support of setting up infrastructure like encouraging the WFVs to buy smart phones, and providing training on using the app, digital payments etc. This study consider it as business as usual (BAU).

Participant	Issues and Enablers
Experts	Technology adoption in the marketing of fish is in the nascent stage among all the stakeholders.
	Technology apprehension and lack of awareness amongst the fisherwomen community is hindering the implementation of m-commerce.
	It is challenging to create awareness and trust in the technology amongst WFVs to adopt m-commerce. Since it is community based enterprise, word of mouth amongst their peers may inculcate trust towards the technology.
Entrepreneurs	When the catch is low, in order to fulfil the commitment, dependency on other traders to fulfil the supply side.
	When the catch is low, to fulfil the commitment of the client, we need to buy the fish from other traders. Contacting the traders is a tedious job.
	An app that can connect traders, wholesalers, and fishmongers would benefit them by buying additional stock or by selling left out stocks.
Woman Fish Vendors	Constrain in carrying more than 30 kgs (two baskets) restricts them from selling more quantity when the demand is high.
	It was noted that WFVs sell off the fish abruptly when the demand is low at a meagre price.
	It was observed that the lack of trust in the modern retailing method is hindering them to explore a better way of conducting business.
	It was an interesting observation to see, at least one member in their family has a smartphone.
	There is an urge to earn more as they are the ones who support their children's education and household duties.
Customer's	They were delighted to know the concept, as it shall help them to locate the right market place to buy a variety of fish.
	They thought that home delivery would save a lot of time and transportation cost.
	With the advent of e-commerce and m-commerce flourishing in India, it was observed that customers would support the adoption of m-commerce to buy fish as it would enable them to buy quality fish at their convenient time.

Source: Author

Table 1: PSM Activity for different stake holders.

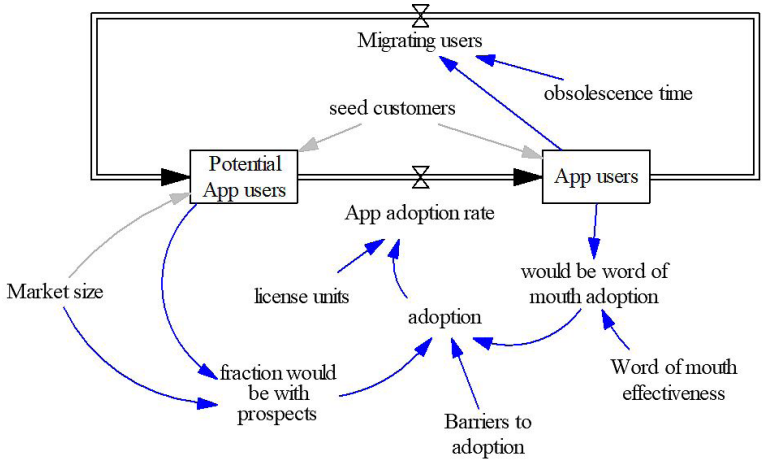


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Figure 4: System Dynamics Model.

Case 2: Varying barriers of adoption with same WOM effectiveness: This scenario represents that the fisheries federation encourages the WFVs to adopt "m-Fish market" app by providing support in setting up infrastructure and training processes, however, the WFVs don't promote the app usage amongst themselves as they don't find it simple to operate.

Case 3: Varying both WOM effectiveness and barriers of adoption: This scenario depicts a situation where the fisheries federation not only involves in setting up infrastructure and training, also the app is made simple and easy to operate amongst the WFVs leading to good WOM.

Based on the above depicted cases, runs were simulated for two scenarios.

Scenario 1: App adoption rate amongst WFVs for the period of 50 weeks.

Scenario 2: Effect of varying barriers to adoption of the app by WFV's at the end of 50 weeks.

Figure 5 represents the Scenario 1 i.e. app adoption rate amongst the WFVs. In case 1, paper studys the effect of varying would be WOM adoption on the total app users. The factor is varied between 0.3, 0.6, and 0.9 respectively representing low, medium and high levels of would be WOM adoption.

It is seen that, under low condition, there is marginal increase the adoption rate at the end of the 50 weeks period. The adoption rate is approximately 2.2 at the end of 40 weeks ass 30 percentage of WFVs have access to smartphone.

In the second case, with a medium condition, it is observed that the adoption rate increasing week by week and reaching the maximum at the end of 20th Week. Though this is more than the previous outcome, it is slightly significant as promotion with 0.6 WOM shall facilitate the adoption rate amongst the WFVs.

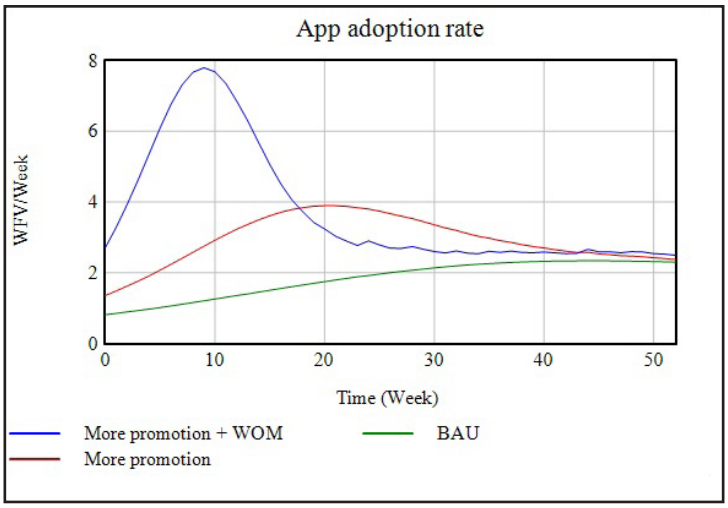
Whereas, in the third case, with a high condition i.e WOM effectiveness is .9, the adoption rate increased significantly reaching to maximum point at the 8th week.

It is worth noting that, the ease of app usage is a parameter that effects the usage amongst the WFVs, but at a higher level, one must observe that, though the willingness to adopt the m-commerce application is significant in the case of the WFVs, mere simplifying the app making it easy to use doesn't help much. Since, it is community based enterprise, WOM places a major role in the adoption of m-commerce.

Figure 6 represents the scenario two. Here paper attempts to study the effect of varying barriers to adoption on the total app users. The factor is varied between 0.7, 0.5, and 0.3 respectively representing high, medium and low levels of barriers to adoption.

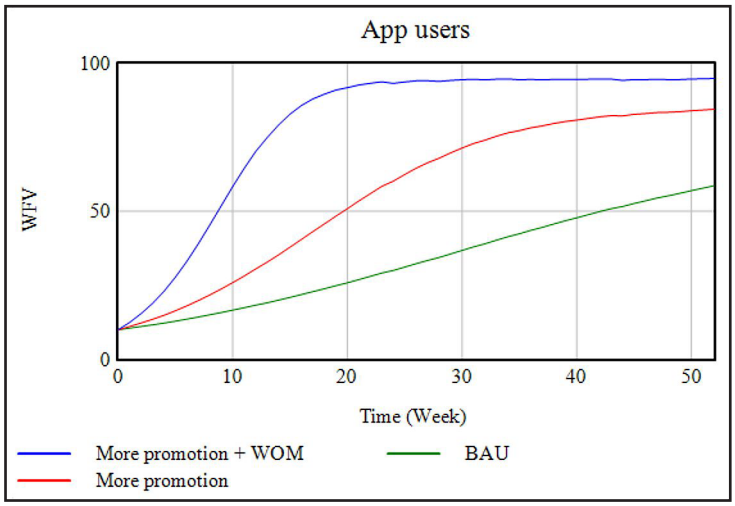
Interestingly, the trend remains to be very similar to what is observed in the previous scenario. Under high condition, i.e higher the barriers for adoptions, there is gradual increase in the number of app users at the end of the 50 weeks period. We see approximately 60 WFVs adopting the m-commerce at the end of the 50 weeks period.

In the second case, with a medium condition, it is observed that the number of app users increase



Source: Author

Figure 5: App Adoption rate amongst WFV's.



Source: Author

Figure 6: App Adoption rate amongst WFV's.

to 60 at the end of 24th week. Total app users increased to 85 at the end of 50 weeks period. Though this is better than the previous outcome, it is not significant.

Whereas, in the third case, with a low condition, the number of app users reached 60 at the end of 10 weeks. There is significant increase in the app adoption by decreasing the barriers of adoption.

It is worth noting that, the barriers to adoption is a parameter that the study assumed would affect the usage amongst the WFVs significantly. One must observe that, though the willingness to adopt the m-commerce application is significant in the case of the WFVs, there existed barriers to adoption in the form of not having adequate hardware infrastructure support and associated training that was mandatory. Hence, it should be noted that, the compound effect of the increased WOM adoption and reducing the barriers of adoption remains a good strategy in the current context.

Discussion

This study is not to show how the results are varying from similar studies, but rather a different methodology to understand the technology adoption among the farmers or the people who fall under base of the pyramid.

To explain user adoption of new technologies number of models and frameworks have been developed. These models explain the factors that can affect the user acceptance such as Theory

of planned behaviour by Ajzen (1985), Diffusion of Innovation theory by Rogers (2003), Technology acceptance model by Davis (1986, 1989), Social Cognitive Theory by Bandura (1977), Unified Theory of Acceptance and Use of Technology by Venkatesh, et al. (2003).

Many studies have used these models on empirical study and rest have combined previous models or added a new component to develop modified models for their research. Very few studies have used system dynamics model to understand the technology adoption amongst the farmers. We have chosen to analyse fisheries sector by using system dynamics model. This is a novel approach to understand the impact of variables on the outcome without conducting an empirical study. In the modelling stage, the PSM framework was used to develop a mental representation, identifying the variables, a causal loop diagram through which a simulation model is developed.

Simulation based study helps the policy maker to visualize the impact of different factors towards the adoption technology over the years of time. This study has considered barriers of adoption and word of mouth as the factor influencing the adoption. Further study may be conducted by identifying each barrier and how it impacts the adoption rate and also research may be conducted on the behavioural aspects of woman fish vendors towards technology adoption and the impacts created due to it.

Conclusion

The WFVs have been the backbone of the last leg of the fisheries supply chain in India in the context of B2C sales. They are considered socially and economically backward. The fisheries co-operatives have been taking additional efforts to empower them. Hence the study of adoption of m-Commerce technology amongst the WFV community is critical for their sustenance as it would provide them with a larger market.

Using System Dynamics, the study was able to demonstrate WOM amongst WFVs and better user interface increased the rate of adoption of the m-commerce. However, it is observed that, due to the under-education levels of the WFVs, significant efforts must be put up to educate them about the benefits of the same. As the WFVs work every day, setting up time for training shall be a challenge. This must be done at the level of the co-operative societies, especially during events like annual congregations etc.

From an academician's perspective, this work presents a new direction towards using system dynamics approach to solve a technology adoption scenario. More specifically, the model developed using SD provides a new direction in the context of model-based policy support in the fisheries sector. This will also be helpful for the policymaking bodies to alter or redefine the policies on a timely basis.

It is still too early to tell whether this approach will lead to a new direction for the WFV empowerment using technology, but this study makes a significant contribution to the literature regarding collation of data and to any researcher willing to apply SD in a related context.

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