A CRITIQUE OF THE CLAIMS ABOUT MOBILE PHONES AND KERALA FISHERMAN: THE IMPORTANCE OF THE CONTEXT OF COMPLEX SOCIAL SYSTEMS

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ABSTRACT

This paper challenges some fundamental aspects of research and conclusions relating to the use of technology for community development. Views of technology, in this case the mobile phone, as a tool for increased economic welfare are often skewed due to extreme reductionism, ambiguous interview questions and poor data sources. Research of complex social systems or sub-systems give the wrong answers when reductionist methodologies are used. To demonstrate such shortcomings, the 2007 paper of Robert Jensen serves as an example. His conclusion that mobile phones enable Kerala fishermen to increase their economic welfare is the most cited paper on ICT4D topics, but there are fundamental methodological and logical problems with the claim, while other research came to contradictory conclusions. This critique is presented on many levels: ideological, paradigmatic, methodology, logical, statistical and semantic.

Keywords: ICT4D, mobile phones, Kerala, fishermen, Jensen, welfare, social systems.

1. INTRODUCTION

As recent as 2014, Robert Jensen's 2007 paper, *The Digital Provide: Information (Technology), Market Performance, And Welfare In The South Indian Fisheries Sector*, is referred to as evidence on how mobile phones supposedly stabilized fish market prices, which resulted in waste elimination, increase in fishermen's profits, and "The overall economic well-being of both buyers and sellers improved." (Brynjolfsson and McAfee, 2014: 95). This is one example from a wide range of other literature that refers to Jensen's findings on face value. A paper promoting the economic benefits of mobile phones, such as Jensen's thus has tremendous impact not just on popular mass media, but even on academic researchers, evidenced by the fact that his paper is the most cited in ICT4D related literature: 627 citations, according to Google Scholar (Steyn, 2014).

At ICT4D gatherings and conferences, informal surveys such as by show of hands, I found that at almost all events the majority of participants are aware of this claim. It has become part and parcel of ICT4D knowledge, or perhaps more accurately, ICT4D legend. Despite this prevalence few skeptical voices are to be found about this claim. In fact, on occasion when some weaknesses of the claim have been pointed out, the claim was vigorously defended. This paper is an attempt to set the record straight.

It is against the backdrop of the mythical nature of claims that ICT improves the welfare of people in developing regions that this critique against Jensen's paper should be interpreted. The critique concerns not only the findings of his particular paper, but also of the conceptual framework of which his paper is an exemplar par excellence, and how sources are cited seemingly blindly. It is a matter of concern that the notion that mobile phones are used by Kerala fishermen to determine market prices, and then go sell their fish at the better markets, achieved such unscrutinized acclaim.

2. JENSEN'S MAIN ARGUMENT, VERY BRIEFLY

The claim that mobile phones are used to increase welfare, particularly among fishermen in the state of Kerala in India, was first made in academic literature by Robert Jensen in his 2007 paper, *The Digital Provide: Information (Technology), Market Performance, And Welfare In The South Indian Fisheries Sector*, published in the *Quarterly Journal Of Economics*.

In very brief and informal terms, Jensen's argument can be paraphrased as follows. Increased welfare is dependent on better market prices. In order to determine better market prices, information is required. The method or tool fishermen use to obtain market information is the mobile phone.

To increase their economic welfare, fishermen need to increase their profit, which means they need to sell at better market prices. Market prices depend on local demands resulting at different prices at different markets. Fishermen do not know which markets offer the best prices. By using mobile phones they can find out the best market prices, sell their fish there, and increase their economic welfare. In addition, market waste is reduced as no fis

From a particular sub-region (Kozhikode), Jensen overgeneralizes firstly to Kerala fisheries, and then to the impact of mobile phones anywhere in the developing world.

He concludes: “By improving access to information, ICTs may help poorly functioning markets work better and thereby increase incomes and/or lower consumer prices. In fact, it has become increasingly common to find farmers, fishermen, and other producers *throughout the developing world* using mobile phones, text messaging, pagers, and the internet for marketing output.” (2007: 881) – my italics.

2.1 Jensen's Data Sources

Jensen's data sources are newspaper articles on mobile usage, fishermen reports on daily catches, and market prices. The data selection about the impact of mobile phones on an economy was done on the basis of four newspaper articles. In the field, questions were posed to fishermen each day during the project. One question was about selling price of fish, and another about whether fishermen use mobile phones. This will be discussed in more detail.

2.2 Jensen's Project

The data for Jensen's research project was collected over a period of nine months from 15 landing centers, repeated over a 5-year period (1996-2001, see Jensen 2007: 890). Market price data was collected between 7:30 and 8:00 “...in order to construct a measure of price dispersion...” (2007: 897) . A specific time slot was idealized as market closing price and prices fetched earlier, or later in the day were ignored. Fieldwork conducted by us found that at some markets fish is sold by 11:00 and later (Steyn and Das, 2015). Jensen does not state how the data on market prices was collected. There seems to have been a different source of this data than the reports from fishermen about their selling prices, which were obtained in the afternoons. Jensen states that in the afternoons interviews were conducted with fishermen regarding that morning's activities. They were asked about size of the catch, how much was sold, price, time of sale, and “whether they used a mobile phone” (2007: 891).

Jensen's paper is an attempt to demonstrate that improved information impacts on market performance and welfare. Based on the theoretical constructs of the First Fundamental Theorem of Welfare Economics, and the Law of One Price, his theoretical conclusion is that based on price information, agents can engage in optimal trade. This theoretical conclusion is then tested in the fisheries industry in three districts of the State of Kerala in India.

Regarding fisheries, he states: “However, a significant limitation to fish marketing is

that while at sea, fishermen are unable to observe prices at any of the numerous markets spread out along the coast." (2007: 881). According to him, mobiles are the solution to observe those market prices. Fishermen can determine the markets with the best prices, and land at those markets. And again: "In this paper, we examine these questions by exploiting the introduction of mobile phones in the Indian state of Kerala as a natural experiment of improved market information." (2007: 880).

2.3 Support for Jensen's Claim

Apart from Jensen's paper, searches found only two papers based on primary research on the theme of mobile usage by Kerala fishermen. In the same year as Jensen's paper, Reuben Abraham published a paper, *Mobile Phones and Economic Development: Evidence From the Fishing Industry in India*. According to Google Scholar, by February 2014, Abraham's paper was cited 163 times.

Abraham wished to test the assumption that mobile phones lessen the information asymmetries in markets, which leads to more market efficiency. Abraham's methodology consisted of a literature review, secondary data, interviews with 50 experts, and field work at 12 locations in Kerala. There is no indication in the paper which landing centers were visited. Abraham states that a case-study was made in Kerala. In footnote 10 he mentions these place names: "...Nagercoil, Tuticorin, Kanyakumari, Coimbatore and so on." (2007:11). This footnote is a reference to the main body text: "The telecom firms have helped the process of market integration by including the nearest big fishing centers outside Kerala within the local network." (2007: 11). This is misleading, as none of these places are in Kerala, and none is even close to the ocean (see the companion website for their locations on maps). Place names in Kerala are not given, and a reader unfamiliar with the geography of southern India might read the mentioned place names as being in Kerala. Abraham's text gives the impression that mobiles are used to integrate these places with Kerala fishing sites quite some distance away.

In his Abstract, Abraham states: "Using mobile phones at sea, fishermen are able to respond quickly to market demand and prevent unnecessary wastage of catch—fish being a highly perishable commodity—a common occurrence before the adoption of phones." (2007: 5). Jensen and Abraham were aware of one another's research, and exchanged information (Jensen 2007: 879 footnote). The statement by Abraham that fishermen use mobile phones at sea does not reference any support by data or argument. Abraham found that in the fisheries supply chain in Kerala, mobile phones are mostly used at the marketing end (the market place), and not at the production end (the fishermen), which is where he expected use. Abraham also sides with Jensen's argument that mobile phones reduce market waste.

Surprisingly, Abraham's own research found that mobile phones are not used on the production side (i.e. by fishermen), but on the market-side. He says: "I started this research assuming that the use of mobile phones was mostly at the production end of the supply chain. In fact, I found that most of the usage occurred at the marketing end." (2007: 15).

The statement on Abraham's page 15 contradicts his page 5 statement quoted above. On one hand he supports Jensen's claim that fishermen use mobile phones at sea to quickly respond to market demands; on the other hand he says that to his surprise fishermen do not use mobile phones – phones are used on the market-side. Something is wrong, somewhere.

Another paper, by John and Jubi (2013), both employed in Kerala, is based on research at 5 locations along 100km of the Kerala coast, but they do not mention which landing centers were visited, although the Thiruvananthapuram District is explicitly mentioned. They conducted focus groups, and did a 15-question survey with 95 individuals. Without offering any evidence, they twice state that mobiles are changing the lives of fishermen. No argument, no data, nor even references to other research is provided in support

of their claim. For example, they state “Mobile phones have changed the lives of thousands of fishermen on the Kerala coast. The cell phone operators have also played a vital role in strengthening this group.” (2013:48). For neither statement is any evidence offered, and these two adjacent sentences lead to the wrong impression that they are semantically related, but logically and factually they are not. The authors do mention that the mobile signal strength was increased, to allow direct touch with agents. They do not offer evidence for the increase in signal strength, and neither do they provide evidence of direct contact with agents. They merely make these statements. They did not even get Abraham's name right, as they refer to "Abraham Reuben" (2013: 48), which should be Reuben Abraham. Given the poor quality of this paper, its conclusions cannot be taken seriously.

There are thus just two primary research papers in support of Jensen's claim: his own paper and that of Abraham – or three, if John and Jubi are to be considered. There are three primary research papers that found evidence contrary to the claim: Sreekumar (2011), Srinivasan and Burrell (2013), and Steyn and Das (2015). Due to space constraints the arguments of these papers will not be presented here in detail, and only brief reference will be made to the main points.

Sreekumar (2011) highlights the cooperative and collectivist culture among Kerala fishermen, which he claims contradicts the individualistic assumption in Jensen's model that assumes fishermen have freedom of choice where to land their craft. Although Sreekumar does not make this explicit, his is an ideological or paradigmatic argument.

Srinivasan and Burrell (2013) raise five issues with the claim. They point out the different characteristics of the north coast (where Jensen conducted his research) and the south coast; that only some actors (not necessarily fishermen) use the mobile phone to determine market prices; that mobile phones are mostly used for purposes other than economic purposes (supported by Sreekumar's discussion of different functionalities of mobiles); that welfare is seldom defined by the actors with reference to economics, but mostly to safety, such as risk avoidance and emergencies; and that the functioning of markets often depends on regulations imposed by government and collectives. The markets are not as free as Jensen claimed. Steyn and Das (2015) found support for the conclusions of both those papers, as well as several other factors casting doubt on Jensen's claim. The fisheries and markets are much more complex and diverse than assumed by Jensen. At best it could be argued that the claim would apply to only a limited number of instances, but certainly cannot be generalized. The claim can most definitely not be generalized to other industries and economic sectors as Jensen did.

3. SOCIAL SYSTEMS

It is often useful for a research project to reduce the complexities of a system into smaller components: the traditional reductionist approach. Findings from such reductionist methodologies could only be preliminary. At some stage the parts need to be synthesized again into some whole. For some systems, such as those involving complex human behavior, any findings from reductionist methodologies need to be painted into an understanding of the larger system, otherwise the wrong conclusions are made. What this means for the present paper is the following. Data collection on singular aspects, such as market prices, might be useful for some or other purpose. But by themselves they do not explain anything about complex social systems. Only once the data findings have been incorporated into a framework of the larger system can claims be made about the particular data set. If the findings of the particular data set do not fit well into the bigger picture, either the bigger picture is wrong, or the data set needs reexamination.

From a broader perspective exactly this lack of fitting data sets into the broader picture has haunted research conclusions in the field of IS and DI, especially by practitioners.

Claims about the advantages or success of telecenters, community kiosks and mobile phones need to be assessed against the social systems within which they function, and not only on the basis of a particular case or technology.

Reductionism might be one reason for the high failure rate of ICT implementation projects in the developing world. Dumping some technology without considering the socio-political context of the location, or complementary systems, the supporting systems (such as maintenance), or infrastructure (not only ICT, but also for example business support structures, energy, transport, etc.) is doomed for failure. These required systems are discussed in a forthcoming paper.

Fisheries is a multiple component system. From a semantic superclass point of view, fisheries is a social system serving the most basic need of humans, food. In more recent historical eras, fish suppliers entered into some form of transaction to exchange fish either for other goods, or for tokens. This process of exchange is labeled economics. While rational economists regard economics as a supra-historical entity with a life of its own, that line of thinking is a relic of an old-fashioned notion with origins in the nineteenth century when German idealist romanticists used organisms as metaphors to interpret the world around us – i.e. organicism (Phillips, 1970).

From a complex systems point of view, economics is a social system, albeit one with particular, and perhaps peculiar, characteristics. To understand fish market behavior, multiple components of complex human behavior must be considered. This implies that an understanding of fish market behavior cannot solely depend on targeting particular behaviors of one stakeholder within the complex system.

For working definitions and concept clarification on the concept of social systems, I rely on the interpretations of Mario Bunge, particularly his *Treatise on basic philosophy* (Volume IV on Ontology, 1979). How his notions compare with those of other theorists of social systems, such as Sen, Giddens, Latour, Castells, Max Weber, Karl Marx, Paolo Freire and others should be left for discussion at another occasion. I find Bunge's concise analysis of conceptual tools useful for the purpose of this paper.

Rational economics is perhaps the dominant economic paradigm, and adherents to this philosophy the dominant source of funding for ICT development projects. Researchers and promoters of the use of ICT for economic development take this for granted. This view reduces humans to *homo economicus*. But as Bunge points out, humans are also *homo faber*, as well as *sapiens*, and *politicus*, and *artifex*, and *ludens* (Bunge 1979: 186), and we could add a few more Latin labels. Reductionist theories do not explain the complexities of humans and their societies well.

Social systems, as interpreted by Bunge, are described with reference to their composition, the environment in which they function, and their structure, which refers to social relations and transformation relations. For the purpose of this paper, Kerala fishing markets thus need to be described with reference to their characteristics, the environment in which they function (social as well as geographical) and the relations between role players and stakeholders. The operations and functionings of fish markets, as a collection of subsystems, functioning within larger societal suprasystems cannot be reduced to singularities, such as by considering only the welfare of fishermen, neglecting the possible impact on the welfare of other role players. Fishermen and the technologies they use (e.g. mobile phones) should not be considered in isolation as closed systems. The complementary and supporting systems should also be considered. As will be evident from the discussion that follows, even without considering fishermen and their use of mobile phones, but considering other aspects of the complexities of fish markets in Kerala, one would be lead to conclusions that by logic alone, it would be impossible for fishermen to use their phones to land wherever

they wished to sell their fish.

Some points in Section 10 in support of the critique against Jensen might at first glance not seem to relate to his arguments at all. However, even if these points might not seem to be relevant to specific propositions, they are relevant to the contexts within which the propositions and their conclusions function. Context, in the sense of an ecology of interrelated systems, may render a logical argument false even if the formal structure of the argument is perfect within its own closed system. Jensen's methodology and conclusions reflect a certain approach to research and operates within the closed systems paradigm of rational economics. There is a problem with the application of such a paradigm in the developing world – as well as in other worlds, but those do not concern us at the moment.

In the following sections more detailed arguments against Jensen's case that highlight not only such high level problems or paradigm differences, methodology and logic, but also lower level specific problems with his paper.

From a systems perspective a system should be researched at least by considering its composition, environment, and structure. The following points contra Jensen present aspects of the composition, environment and structure of Kerala fisheries. Each point on its own should cast doubt on the arguments of Jensen. Together they weigh very strongly against his case.

4. METHODOLOGY – THIS PAPER

In addition to desk research, fieldwork was conducted in 2014 at fourteen landing centers in Kerala, as well as visiting a few more, covering both the north and south coasts, and with a spread ranging from informal beach sand markets to formal markets in well-constructed permanent buildings. Fieldwork findings are reported in Steyn and Das (2015). The present paper does not report on this fieldwork, but is certainly informed by our visits.

The visited centers are listed with photo evidence on the companion website (Steyn 2014). During fieldwork the methods of participant observation and informal conversational interview were followed. The methodological foundation is based on an inductive, exploratory approach.

Interview styles and techniques differ. One point of critique against traditional or standard interview styles is that the questions posed by a researcher already frame the answers. This might lead to bias. For this particular research project it was decided to rather follow a blend of the methods of informal conversational interview (Patton, 2002) and emergent interviews (Glaser, 2001). The notion of unstructured interviews was also useful (Zhang and Wildemuth, 2009). These more informal and “natural” interviews, i.e. following a conversational style, lead to deeper insights, and even when the researchers steer the conversation into certain directions, do not suffer from the framing problems of classic interview styles. In the words of Patton, “Informal conversational interview relies entirely on the spontaneous generation of questions in the natural flow of an interaction, often as a part of ongoing participant observation fieldwork.” (Patton, 2002: 342).

Our approach was to initiate casual conversations, and if the dialogue allowed for it, to prompt responses about the use of mobile phones. On many occasions people at the market or on the beach would start a conversation with us. At most of the markets, on almost all days during the fieldwork, we were at the market from its “opening” to its “closing”. On many occasions we were there even before the market opened. There is no official opening or closing time. Bidding starts when the first boats land, while “closing” is perhaps a misnomer. For example, once boats stop arriving, and all fish have been sold around mid-morning, some folk would still hang around. We were told that even though the market looks closed, some boats might still arrive later in the morning or even afternoon. We usually left the market

when it appeared to us that we would not be able to gather more information, which typically was late morning. Some landing centers we also visited in the afternoons.

Before we began conversations, we would hang around at fish landing centers and observe (along the lines of DeWalt and DeWalt, 2010). On some occasions, locals would initiate conversations with us. Being dressed in western clothes we stood out against the loin cloths and saris. In most such cases locals thought we were tourists.

Informal conversational interview and emergent interview approaches are not structured, and conversation topics vary. Given the scene and context of fishing, most conversations would begin within that framework. Given the many types of role players and stakeholders, individual interests in fisheries vary, and conversations would focus on particular interests. Despite our main focus of attempting to determine the use of mobile phones and fish markets, no two conversations were the same. This implies that actual numbers of interviewees are to a certain extent irrelevant. In total we conversed with more than a hundred individuals with a variety of stakes in fish. We obtained quite an in depth view of how the fish markets operate.

Some conversations were ended before we could get to a point of diverting the conversation to mobile phones. For example, we might be in a conversation with an auctioneer with the hope of eventually steering the conversation into how mobile phones are used and for what purposes, but then someone demands his attention, and the conversation came to an end. In such cases even though we might not have obtained mobile related content, the content provided by such conversationalists would be rich enough to make informed deductions about how the fish markets operate within the broader context. For example, an auctioneer stated that he sponsors a few boats, and that the fishermen are required to deliver the fish at his home base landing center. Nothing was said about whether mobile phones were used to determine market prices. Yet, from such type of statements it is evident by deduction that even if mobile phones were used, fishermen do not have freedom of choice of where to land with their fish, which nullifies Jensen's generalizations. It should be evident that given our qualitative approach, the quantitative number of interviewees is not decisive. Although conversations were had with more than 100 individuals, not all reported on the same matters.

Given this methodological backdrop, specific problems of Jensen's research will now be addressed. The more common problem of confusion of correlation and causation is first addressed, then the problems of overgeneralization and of the complexities of social systems. These are higher level problems. Following these three points of critique, specific aspects of Jensen's case are addressed.

5. LOGICAL PROBLEMS WITH JENSEN'S PAPER

5.1 Confusion of Correlation and Causation

A confusion between correlation and causation is perhaps one of the most common methodological errors committed not only in mass media, but also in academic literature. Bunge (1979) distinguishes between logical (defined in terms of the joint assertions of two propositions) and ontological (defined in terms of a concomitant occurrence of two events) constant conjunction. In both cases it is an error to assign causation to the conjunctions. Statistics, put perhaps in oversimplified terms, provides tools to describe patterns that can be observed from inputs by applying some operations on the data. It describes patterns and unknown data point sources are assumed to hide somewhere in those patterns. That is what statistics does. It provides descriptive tools. When two sets of data present the same patterns, there is no statistical method that assigns primacy to one such pattern being the cause of the other. Additional cognitive constructs are required to relate the different sets of patterns. As

first construct, a set of arguments needs to be offered on why the patterns should be related at all.

To drive the point, consider some of the ridiculous correlations that could be made when statistical patterns are followed blindly without additional cognitive effort. Vigen (no date) presents many graphs of spurious correlations that no rational person would assign causal relations to. For example, there is considerable correlation in the patterns of data on civil engineering doctorates awarded and per capital consumption of mozzarella cheese. Why would we not assign causal relations to such spurious correlations? Because our world-view, stock of cultural knowledge, paradigm or theoretical framework would not allow us to do so. Yet when it comes to, for example, correlations between technology and economy, scholars often assign causation to ICT in this set. Patterns described by statistics might show correlations. But assigning causation to either pattern results from paradigm or theory. Theory and assumptions overlay the pattern – the pattern itself says nothing about causation.

Typically proponents of ICT would assign a unidirectional causality to ICT's influence on the growth of an economy. Logically, of course, the direction might just as well been the other way around: that economic growth causes growth in ICT. Whichever has more ontological weight, it remains an error to assign causation to correlations.

Brynjolfsson and McAfee refer to an earlier study of Brynjolfsson and Mitt which found a correlation between increased IT use and productivity, and concluded that "... firms that use more IT tend to have higher levels of productivity..." (2014: 104). The gist of their argument is that increased use of IT causes increased productivity. None of many other possible causes of increased productivity is considered. One possible alternative and obvious cause is that because of market growth there is more money to spend on IT – an argument offered by Carr (2003, 2004, 2005). More detailed arguments about this problem concerns the productivity paradox, dealt with elsewhere (Steyn and Kirlidog, 2013). To accept one apparently obvious possible cause is a symptom of jumping to conclusions bias.

It should be noted that Harry's 1980 argument that in principle it is not clear that ICT's cause economic development has not been refuted yet. Hardy acknowledged that ICT, in his day the telephone, indeed serves as a catalyst in the economic landscape, but not as a causal factor. It is a matter of concern that so many decades later the basic logical error of confusing correlation with causation is still made in academic literature.

Jensen's argument is based on two premisses: mobile sales increased; fish market prices increased, which increased fisherman's profits. Since the increases occurred during the same historical time span, Jensen assumes this correlation implies unidirectional causation. He concludes: "The identifying assumption for the empirical strategy is that, had it not been for the introduction of mobile phone service, there would have been no differential changes in the market outcomes across these regions over this period." (2007: 903), and "We find that the addition of mobile phones reduced price dispersion and waste and increased fisherman's profits and consumer welfare." (2007: 919). There is a fundamental flaw with this reasoning. It assumes the primacy of causality in one direction only. Logically, the other direction could also be true: because fish markets were better (due to a host of other possible reasons not related to mobile phones) fishermen could now afford mobile phones. This reverses Jensen's argument: it is not mobiles that cause better economic welfare, it is better economic circumstances that increase mobile sales. Jensen's assumption that the direction stems from mobiles to increased welfare has not been substantiated; he also did not consider the opposite direction.

By confusing the correlation between mobile sales and market price stabilization with causation, Jensen committed the logical error of *cum hoc ergo propter hoc*. There is no certainty that any causality could be assigned to increased mobile phone usage and fish

market price stability. Several other correlations can be identified for the same historical period, but he hastily overlooked them as he wished to make a case for mobile phones. Although he indeed mentioned that other possibilities for the increase in market prices might exist, he did not discuss them, and neither did he argue the case for mobile phones. He merely accepted the primacy of mobile phones (based on some newspaper reports).

There are many other possible factors for increasing fish prices. Here only four alternatives are mentioned:

a. Population growth (*Kerala Centre for Development Studies* 2006): Since the 1980s Kerala's birthrate has been declining, and the rate of decline increased in the 1990s. The effect of this is that households now had fewer mouths to feed, thus had more expendable income, and could now afford to buy more fish, or even afford to pay higher prices. This in turn might drive up fish prices. This argument is based on the economic law of supply and demand. Perhaps, following a mono-causal line of argument, declining birth rate and not mobiles lead to better fish prices and increased welfare.

b. Increase in industrialization and manufacturing in the period 1990-2010 (Matthew, no date). The ripple effect of increased production would lead to more jobs, and in keeping with typical growth patterns, lead to an increase in income, with the same result as point 1 above: more income to spend. Economists such as Robert Solow regard increased productivity as the impetus for economic growth. It is most likely this growth, rather than increase in mobile phones that lead to the increase in fish market prices. There is a strong school in economic theory that relates increased productivity to economic growth. Such growth typically enables more spending money, thus for consumers to buy fish at higher market prices.

c. Migration and remittances (Singh 2012). Over the past few decades, a growing number of Keralites work overseas, especially in the Middle East. By 2012 such remittances generated 22% of the Kerala GDP. This higher income results in more spending money, and in turn more people could afford to buy fish, which in turn lead to higher market prices because of the law of supply and demand.

d. Growth in landline phones (*Kerala Centre for Development Studies* 2006). For the period 2002-2003, which is within the timespan that Jensen considered, landline phones increased by 2.8 million in Kerala. Jensen nowhere mentions this, which indicates that his research did not consider all the possible factors within the sphere of ICT. As will be pointed out later, he never discussed any of the other communication technologies used by fishermen, but stuck to his mobiles guns. If it were possible to make an argument that increase in the use of ICT leads to economic development, then perhaps it is not the rise in mobile phone sales that drove this, but the increase in landline phones.

Jensen commits the error of confusing causation with correlation. Even if the graphs for mobile growth and economic growth show correlation, there is no causation. No matter how much data is collected, or how many fishermen state they use mobile phones, causation cannot be determined.

In addition, Jensen shows a good dose of confirmation bias, blind to options other than the one he wishes to promote, the case of mobile phone growth.

5.2 Overgeneralization

Although his research was done in three Kerala districts, the title of Jensen's paper (“...welfare in the south Indian fisheries sector”) suggests impact not only for Kerala but other southern states of India too, by implication also Tamil Nadu, as well as Andhra Pradesh, Karnataka and Goa. He found that only in one of the three regions did fishermen sell at markets other than their local ones. Keep in mind that the crux of his argument is that fishermen can land at any market where prices are better, and that they use mobile phones to determine the best prices.

For the purposes of his paper, Jensen divided the northern area in which he conducted his research into three regions. These "regions" are his own constructs, and not the formal state districts. In region I (Kozhikode) "...about one third now sell their catch outside their local market. By contrast, all fishermen in regions II [i.e Kannur] and III [i.e. Kasaragod] *continue to sell in their local market*." (2007: 896) – my italics. According to Jensen's own research, fishermen of only one of his regions, or five landing centers, sold fish at markets other than their home markets. None of the other landing centers at his other two regions did this. The five Kozhikode markets at which he did research are: Chombala, Badagara, Quilandi, Puthiyangadi, and Chaliyam. Thus, the fishermen of only 5 of the more than 200 (or 2.5%) landing centers in Kerala sell at other markets. Yet he overgeneralizes his findings to apply to the whole of Kerala, the whole of south India, and eventually to the world. Based on such a small sample, generalizations may be skewed. Given our own findings, and those of Srinivasan and Burrell, a good dose of skepticism is required regarding this conclusion.

There are two markets called Chaliyam. The Chaliyam visited by Jensen and by Srinivasan and Burrell, is most likely the one also known as Beypore-Chaliyam, on the northern bank of the Chaliyar River. There is another, more informal market on the southern bank of the Chaliyar River, also known as Chaliyam, near the village of Feroke, a suburb 16km south of the Kozhikode metropolitan area. Chaliyam is one of the five Kozhikode markets mentioned by Jensen and part of his "one third" set of which fishermen go to other markets.

As reported by Srinivasan and Burrell (2013), the Chaliyam market is served by mechanized mini trawlers, vallams, some with outboard engines, some muscle-powered. The authors' vignette describing the beach market at Chaliyam is typical of what we found at all markets, except at the largest ones, and small informal beach sand markets. I am not sure how Srinivasan and Burrell define mini trawlers, as the craft we encountered here are the largest we have come across at all landing centers we visited – see the photo evidence on the accompanying website.

The majority of boats are large trawlers with fully mechanized nets. These boats veer far into the ocean, according to our conversationalists typically 70Km and further, which is well beyond the range of mobile phones. At Beypore-Chaliyam we were told such boats have a crew of up to 60, while the informants of Srinivasan and Burrell report up to 50 people. Agents (or *tharakan*) advance between 2 *lakhs* to 10 *lakhs* (approximately USD1500 - USD15'000) depending on the size of fishing operation, and require boats to return the fish harvest to them. Srinivasan and Burrell (2013) mention advances of 60-75 *lakhs* (USD90'000 and more). Conversationalists informed us that mobiles are not used on the boats as they are out of range. These trawlers are equipped with two-way radios, depth sounders and GPSs. Mobile phones are not used to determine market prices.

What is important is that the craft at Beypore-Chaliyam are, in our view, really large and sophisticated trawlers with fully mechanized nets using several communication technologies.

Jensen acknowledges that it is only the largest fishermen who adopted mobile phones: "However, the evidence here suggests that the benefits of ICTs can be found among fishermen or farmers, not just software engineers or call-center workers. Further, while it was *primarily the largest fishermen who adopted mobile phones* in the present case, there were significant assumptions regarding his claim of spillover gains for the smaller fishermen who did not use phones, due to the improved functioning of markets. Thus, rather than simply excluding the poor or less educated, the 'digital provide' appears to be shared more widely throughout society." (2007: 920) – my italics.

Several points need to be highlighted regarding this statement. There are semantic as

well as evidence problems. It is not clear whether with “large fishermen” he refers to business corporations, to boat size or to the size of the catch. As indicated further below, catch size is determined by boat size, among other things. Perhaps he meant trawlers. That means that his conclusion does not apply to Chaliyam as no large trawlers land there. It might apply to Beypore across the river, but we found no evidence that trawler fishermen phone about markets prices. On the contrary, trawlers veer off too far into the ocean for mobile phone reach, and on the other hand, they have other communication tools that are typically used. In addition, even for the larger boats, *tharakan* give advances and expect the boats to return to them. The smaller boats at Chaliyam fish much closer to the shoreline, and can thus use mobile phones. Srinivasan and Burrell do not explicitly mention mobile phone use at Chaliyam, and in our own research, we found no case where mobile phones were used by smaller boats to determine market prices.

Jensen's statement that there is spillover is a conjecture. It seems that the notion of spillover was introduced when Jensen realized that at only five of the centers he visited fishermen use mobiles for market prices, and that these were the “largest fishermen”. These large ones are typically corporations, not the small fishermen, who seem to be his concern – to increase the economic welfare of the poorer non-corporate fishermen.

He offers no evidence for any spillover. It is just a statement. Most of Jensen's claims are not supported by corroborating evidence, and seem to be based on conjecture. Yet, his conclusions based on conjecture became the waiving flag in many ICT4D conversations. The puzzling question is why there are two contradictory camps regarding the use of mobile phones among Kerala fishermen. Given the analysis thus far, I can only conclude that the claims of the Jensen camp are based on positive findings at five landing centers, logical and methodological errors, and a host of conjectures. If this is true, there is concern about research in ICT4D. Without any scientific or methodological rigor, a few unsupported claims reached epic attention, and the banner held high that mobiles lead to increased economic welfare. More worrying, is that ICT4D participants blindly follow such claims.

The jump from possible findings at five locations to the whole world requires an extraordinary long logical leap. Jensen concludes: “... fishermen, and other producers *throughout the developing world* using mobile phones, text messaging, pagers, and the internet for marketing output.” (2007: 881) – my italics. This is not science.

The claim that ICT has a causal force in economic development is widespread among technosalvationists. This claim relates to Robert Solow's notion of the productivity paradox, which he introduced in response to claims that companies that use telecommunications will have an advantage for growth. Solow pointed out that in cases such as the Japanese economy, technological revolution correlated with economic slowdown. There is thus no positive correlation between technology growth and economic growth – hence the productivity paradox (see Steyn and Kirlidog, 2013). The argument that ICT leads to economic welfare is very far from being settled. The argument that ICT will lead to economic growth in the developing world still needs to be made.

6. JENSEN'S METHODOLOGY AND EVIDENCE

6.1 Ambiguous Question

Jensen's interviews with fishermen were conducted in the afternoons regarding that morning's activities. Fishermen were asked about size of the catch, how much was sold, at what price, and the time of the sale. They were also asked "...*whether they used a mobile phone*." (2007:891) – my italics. A question about use in the general sense, and a question about purpose of use are semantically different. Jensen does not report whether these nuances were made explicit. It is quite possible that fishermen interviewed had the general meaning in mind

when responding to the mobile question. The words he indeed used merely indicate *that* mobile phones are used by fishermen, and not *what* they are used for. As presented, his question to fishermen is ambiguous.

The suspicion that the question was most likely ambiguous receives indirect support from other research. Sreekumar (2010), Srinivasan and Burrell (2013) and Steyn and Das (2015) conclude that fishermen indeed use mobile phones, but, it seems to be for purposes other than determining market prices. Jensen did not consider other possible functionalities. He merely assumed that mobiles are used for business. Steyn and Kirlidog (2013) point out that even in the economically highly developed USA functionalities such as personal communication and entertainment are the dominant functionalities of mobile phones, not economic activities. Sreekumar (2011), Srinivasan and Burrell (2013) and Steyn and Das (2015) found the same among fishermen in Kerala. If mobile phones are not predominantly used for economic purposes in highly developed economies that have advanced technological infrastructures, it is a hard push to make an argument that mobile phones are used for economic development in regions with poor telecommunication infrastructure.

The most common use of mobile phones seemingly all over the world is for non-economic activities. If Kerala fishermen differed from this norm, it would have strengthened Jensen's case. The research projects contra Jensen's case found that the most common use of mobile phones among Kerala fishermen fits in with the global profile. Had they indeed used mobile phones to determine market prices, Jensen would had to make a case why Kerala is different. The conformance to the global profile rather suggests that Jensen's question posed to fishermen regarding mobile phone use was ambiguous.

6.2 "Evidence" of Mobile Phone Use

Jensen's "evidence" for the use of mobile phones for marketing output is based on four newspaper articles: Arnold (*The New York Times*, 2001), Rai (*The New York Times,* 2001), Alam (*Sydney Morning Herald* - 2005), and LaFranier (*The New York Times,* 2005).

Based on the marketing evangelism of mobile operators, Arnold (2001) reports that in Thailand shrimp farmers call Bangkok markets directly, bypassing the traditional middlemen. Also based on the materials supplied by a mobile operator, the same claim is made for the Philippines about vegetable farmers. Reports by mobile operators are not based on scientific research methods as they are typically designed to keep shareholders happy and for marketing purposes.

In similar hyped language, Rai (2001) sang the praises of mobile phones, and claimed 5,000 fishermen in Kerala used mobile phones and concludes that "...rural India has discovered the convenience of doing business on mobile phones". It is unclear how that number was obtained. I could not obtain data for the number of active fishermen in Kerala for the year 2001 when that article was published, but the *Marine Fisheries Census 2010. Kerala.* (2010) report 145,396 active fishermen, of which 36,906 used mobile phones. Rai's 5'000 constitutes less than 5% of these fishermen, while a decade later, based on the census, the figure only rose to 25%, which does not really support Rai's enthusiasm. A growth from 5% to 25% over a period of a decade is not particularly exciting for mobile sales. Rai further reports the words of a Mr. Karthikeyan: "Life without a mobile phone is unthinkable". It is not clear what Mr. Karthikeyan had in mind, but other research shows clearly that the dominant functionality of mobile phones is not for business. Was Mr. Karthikeyan reporting on life being unthinkable without mobiles for not being able to communicate with family and friends, or about business?

Alam (2005) claimed that in Bangladesh mobiles cut out middlemen and allow the poor to deal directly with buyers. This seems to be based on a single interview with a fellow called Jahid Hussein. Alam also claimed that farmers in China use text messages to find out

about prices, weather forecasts and pest control, but how this information is obtained is not specified. Alam cites the growth in Chinese mobile subscribers, but such subscription growth does not imply growth in use for business. Such statements are mixed together and a conclusion baked that mobiles assist the economic welfare of the world's poor. A giant leap indeed.

LaFraniere (2005) reports on the use of a mobile phone by a fish vendor along the Congo River. However, that use is not based on scientific research, but on information released by the Vodacom mobile operator.

Jensen bases his premise on the vagueness and hype of newspaper articles. Being newspapers, none of the authors give scientific evidence for the statements and claims of the economic benefits of mobile phones. This dependency mislead Jensen to commit a double error. Not only is no properly research evidence presented on how mobile phones contribute to economic welfare in these cases, but mobile phones are also assigned a causal role in the chain of events, thus committing the error of *cum hoc ergo propter hoc*.

7. JENSEN'S ECONOMIC ARGUMENTS

7.1 The Alleged Importance of the Fishing Industry in Kerala

Jensen grasps for economic reasons in support of his conclusion. He claims that “Fishing is an important industry in Kerala” (2007: 881). He implies that if mobiles can be used to improve the welfare of fishermen, it demonstrates the power of mobile for an economy. His baseline assumption is: mobile phone use by fishermen contribute to Kerala economy, and by implication the growth in the Kerala economy might be due to the growth in mobile use.

However, fishing is not an important contributor to Kerala GDP. While in 2007 Indian fisheries contributed 4.3% to the agricultural GDP, with exports of 460,000 tons to the value of Rs 68 billion (Salim, 2007), its impact is not so much on the national economy than on the informal sector. Fisheries contribute a relatively small portion of the national and of state GDP. Small-scale fishermen, who do not contribute to state taxes and thus to GDP, are an important source of food supplies. About six million people (0.49% of the Indian population) are employed in fisheries related industries. The importance of fisheries is in the informal sector rather than for GDP.

Kerala has the fourth largest fish production of India, but contributing only 9% of all Indian fish. According to the Government of Kerala website (Department of Economics and Statistics, Thiruvananthapuram, 2013), fishermen contribute about 9% of agricultural GSDP (i.e. State GDP). Since 2005 the Kerala GSDP has increased 69%, while the fisheries sector declined from 1.3 to 0.82%. Remittances by Keralites working outside India, on the other hand, contribute 22% of Kerala GDP (Singh 2012). The Kerala fisheries is thus not economically so important.

Fishing in Kerala seems to benefit the subsistence sector of the market the most. This point relates to other arguments implicit in Jensen's case. His project should have considered the small-scale subsistence fishermen. If it were found that mobile phones benefit them, Jensen would have had a strong case claiming importance for this industry. But as we will see below, he targeted the affluent trawler-based markets in the north of Kerala.

If Jensen wished to make a case for the growth impact of mobiles on the Kerala economy, he should have investigated some other sources, such as industrialization and manufacturing or migration and remittances, discussed above.

7.2 Welfare

Jensen assumes that well-being is defined in terms of economic welfare. Several thinkers, particularly Amartya Sen (1975, 1987, 1992, 2001, 2002), and Arturo Escobar (1996, and

later 2012), have long before Jensen's paper defined well-being in a much broader sense, with economics merely a sub-component. From a complex social systems perspective, the narrow view of welfare should not be supported as welfare has many dimensions, economic welfare being one, and not necessarily the most important one. There is growing concern about the economic growth bias of ICT4D work, as also mentioned by Sreekumar (2011). The global growth in mobile sales and usage points to the use of ICTs, particularly mobile phones, for basic human needs, such as communication with family and friends, and entertainment, thus social and psychological welfare.

The fieldwork of Srinivasan and Burrell (2013), and Steyn and Das (2015) found that fishermen do not really use mobile phones for economic welfare, but for emotional and social welfare - to keep in touch with family and friends - and for safety. Jensen's argument that mobile phone usage by fishermen increase economic welfare thus does not stand.

7.3 Waste

At Badagara Jensen observed 11 fishermen dumping their catch because it could not be sold, leading to waste (2007: 882-883). He claims that 15km from Badagara there are 27 buyers who could not buy fish. He does not state whether that market was exhausted. It could also be possible that those buyers could not afford the fish sold at that market, which is why they could not buy fish, which lead to waste.

Jensen's point about waste is presumably that when there is an excess at a particular market, fishermen could quickly fire up their boats and travel to other markets where there is a shortage of fish supply. If this interpretation is indeed what he intended with the Badagara statement, he certainly does not understand the fisheries of Kerala. Steyn and Das (2015) found that profit margins are small, and most fishermen need to obtain loans just to maintain their boats. Many are also dependent on subsidized fuel, obtainable only to the landing centers where their boats are registered. No evidence at all of market hopping was found. On the contrary, given the typical constraints of market customs, and the fact that most fishermen just want to go home and sleep after a night's hard work, it can be stated with certainty that wastage will not be reduced using the suggested approach.

Jensen further claims that mobile phones lead to “the complete elimination of waste” (2007: 879). His definition of waste (and that of Abraham 2007) is about excess stock at a particular market. This certainly would lead to waste, but waste also has other meanings. The most pressing problem for the Indian fisheries is not such market waste, but production waste.

There has been concern about excessive fishing (*Third National Report to the CBD*, 2005). Murugesan, Purusothaman and Muthuvelu (2012) cautioned about the impact of trawl nets on biodiversity at Parangipettai and Cuddalore, as the unintended by-catch of the main catch implies wastage, but worse, the inclusion of juveniles shorter than 15cm. This caution applies to fishing areas all over the world.

Production waste refers to unintended by-catch when using nets, which includes juvenile fish shorter than 15cm. If the net mesh size is too small, juvenile fish also get caught, which prevents them from reaching procreation maturity, which in turn depletes the stock. Kumar and Deepthi (2006) point out that although the by-catch has no immediate economic value, it depletes the long-term stock. To address the by-catch problem, fisheries authorities introduced regulations that net mesh sizes must be larger than 15cm, and no net fishing is allowed during the spawning season June, July and August, which incidentally is at the same time as the monsoon rains (Salim, 2007). Despite these measures, unintended by-catch remains a problem. For the fisheries industry production waste is certainly a problem, but not the market waste that Jensen highlights.

The argument put forward by both Jensen and by Abraham is based on a secondary conjecture. They assume that fishermen can sell their fish at markets other than their home base. At those other markets there is more demand (based on the higher market price, thus following the law of supply and demand), and therefore the fishermen would sell all their fish. This is a conjecture. There is no guarantee all the fish would be sold. If a large group of boats suddenly decide to sell their fish at the landing center with the best market price, that particular market would suddenly be over-supplied, leading to a drop in the market price. Perhaps the first few boats would have been able to sell at the higher prices, but the late comers would loose out, and most likely would not be able to sell their fish when the market has been saturated by the sudden over-supply. This would in fact lead to more waste.

The waste argument is not an argument, but a conjecture based on patterns of high-end abstract and "rational" markets that does not hold up to logic, nor the real material world of fisheries in Kerala.

8. USE OF COMMUNICATION TECHNOLOGY

Data from the *Marine Fisheries Census 2010. Kerala.* (2010) shows that of the 145'396 active fishermen, 36'906 (or 25%) used mobile phones. The Census does not report purpose of use, nor whether mobiles are used for business purposes. Globally functionalities other than economic dominate the use of mobile phones - not only in the developing world, but even in the developed world. This has been pointed out by, among others: Alampay, Alampay and Raza (2012), Anwar and Johanson (2012), Nyamarebvu and Van Belle (2013), and Steyn and Kirlidog (2013). The same is true about Kerala fishermen, as pointed out by Sreekumar (2011), Srinivasan and Burrell (2013) and Steyn and Das (2015).

During good weather conditions the reach of mobile phones is roughly 20km. This is well out of reach of trawlers, who venture as far out as 200km into the ocean. The 70km distance from the shore mentioned by our conversationalist at Beypore referred to that particular case. Ironically, the smaller fishermen who fish just about 2km off shore would benefit the most from mobile phones, but apart from communicating with their financiers and family, they do not communicate about market prices (Steyn and Das 2015). Jensen is thus wrong on both accounts: trawlers cannot use mobiles as they are too far out to sea, while those craft that can indeed use mobiles to determine market prices do not, or even cannot do so for a variety of reasons, as pointed out.

Totally absent from Jensen's paper is the consideration of some of the other ICTs commonly in use in the fisheries industry, such as broadcast radio, radio ham, pagers, and landline phones.

As recent as 2013, the *Southgate Amateur Radio News* (unknown author, 2013) reported that Indian fishermen demand government support for free ham radio and GPS gear especially for the purpose of obtaining weather information (by implication, for their safety). If mobile phones were indeed used to obtain weather information, as many authors have claimed over the past decade, why do fishermen as recently as 2013 demand a technology other than mobiles for this purpose? A mobile app would do a pretty good job at relaying weather information, yet the appeal is not made for such an app. There is a simple explanation for this: trawlers travel far beyond the reach of mobile phones (and can of course not phone to determine market prices). The article mentions that a large number of craft (which is not specified) travel as far as 200 miles from the shore. It is obvious that mobile phones cannot reach that far. But it is equally obvious that these fishermen then cannot use mobile phones to determine market prices. If trawler fishermen are in anyway connected to the shore via radio, why would they need mobile phones to determine market prices? One could offer several functional reasons but none were offered by Jensen. For 2-way radio both sender and receiver must have similar access devices, and be on the same frequency -

although such an argument would apply to mobiles too; of course mobiles are multi-functional, and access just so much easier than 2-way radio.

Delivering content in multiple languages on the web or mobile devices is technologically speaking relatively low-tech. So one would think that projects assisting fishermen would give preference to mobile phones as content can be delivered relatively easy in multiple languages. Yet, in 2012 Rotary made a press release about launching a local language radio marine weather forecast service for fishing communities by means of a community radio FM station (Rotary Showcase 2012). The language was not mentioned. A former merchant navy officer transcribes weather reports into some language, which is then broadcast three times a day. Why is this old-style radio broadcast about weather conditions necessary if literature claims that fishermen use mobile phones to obtain weather information? Such claims seem to be suspect. Supporting data that might serve as evidence that mobiles are used to access weather information is lacking.

In 2013 the State of Tamil Nadu announced that VHF (very high frequency) radio communication equipment would be subsidized to allow fishermen to install them on their deep ocean fishing boats (Satyanarayana 2013). This equipment, and not mobile phones, would be used to obtain weather information, information for effective fishing, as well as warning system against attacks by the Sri Lankan navy.

A respondent in Sreekumar's research project mentions that pagers were introduced for use, presumably by fishermen, and walkie-talkie, while later mobile phones were used (2011: 177). It is not clear from the narrative snippet whether pagers and walkie-talkies are different devices, or synonyms for the same device. Technically, they are different devices, as a walkie-talkie is a two-way radio, while a pager is an instant messaging device, typically just a one-way display of a brief message. In the case of the pager, responding to a message requires using another communications device, such as a telephone. More advanced pagers allow for a response on the same device. The snippet also does not make clear whether the pagers in use were one-way or two-way. Although the details are vague, it is clear that a number of different communication technologies are used by fishermen along the Indian coast. Much more specific research is required to determine the functionalities of the different devices, and whether their functionalities overlap or not. Before such research is conducted, it is pointless to make generalized claims about mobile phones, as seems to be the custom in ICT4D literature. More useful to ICT4D would be to determine whether other ICTs are perhaps used to determine market prices. If not, why? And how do the different devices complement one another? If mobiles are indeed more efficient, how could those functionalities performed by other artifacts be replicated on mobiles? Why is this not presently done in the fisheries industry?

The *Annual Report 2006-2007* of the Ministry of Earth Sciences of the Indian Government contains information relating to fisheries and telecommunications. By 2006 it hoped to have distributed 3300 faxes/phones to all Potential Fishing Zone (PFZ) communities. Climatic information was displayed on electronic boards at Veraval, Panjim, Vypeen, Veerampattinam, Thengaithittu, Nagapattinam, Thangachimadam and Visakhapatnam, and also distributed via email. An Interactive Voice Response System was set up at 26 locations for users to obtain weather information through telephone services. Localized weather reports, with 5 day period forecasts, were released daily on the web for 440 stations over India. Although this report mentioned several weather reporting systems, the use of mobile phones was not mentioned. Yet, too many authors have claimed that fishermen use their mobile phones to access weather reports,

A report in John's blog (2012), mentioning Kerala, stated that India's marine weather radio broadcast only went on air in July 2012 (also see Satyanarayana 2013). An important

purpose of this service, broadcast at VHF (Very High Frequency), is to warn fishermen of wind speed, when it exceeds 20 knots (or 38 km/h). This service is mainly for Tamil Nadu, Kerala's neighboring state and the Indian state with the most landing sites, and the fifth largest fish production. The blog ends with tips of precaution for setting out into the ocean. GPS is mentioned, but very conspicuously, there is no mention of the use of mobile phones to find out about weather. This is not surprising, as mobile networks fail in poor weather conditions, while VHF can penetrate much further. The claim that mobiles are used to access weather reports is misleading. At best, such services are accessed while the fishermen are still on shore (in which case any other ICT could also be used), or close to the shore. The further craft veer off into the ocean, the less reliable mobile communications become.

Other artifacts of communication could also be used by financiers to signal their *vallams*, which typically fish within sight about 2Km from the shore. A system of flags, or even megaphones could also be used. Mobile phones are just one type of technology that could be used for this functionality. If this functionality had been essential to determine market prices, long before the arrival of mobile phone technology other devices could have been used. Here is an alternate scenario. A financier could determine better market prices by landline phone. Several communication symbols or technologies could be used to communicate to the boats 2km from shore. A symbolic system of swinging arm signs is possible. So is a system of flags, or using a megaphone. Why wait until the advent of mobile phones to communicate with boats if this is so important for markets? The fact that no such customs exist to direct boats to better markets implies that if mobiles were indeed used for this purpose, they introduced a whole new custom to Kerala fishing behavior.

Radio has been used for a long time by trawlers, so it cannot be argued that mobile phones made possible determining better market prices - otherwise radio would have been used. If that goal was important, other technologies would have been used before the arrival of mobile phones.

Jensen never addressed the matter of whether other technologies have been used to determine market prices before the arrival of mobile phones. Also, our research found that mobile phones are used for the *when*, rather than for the *where* to land. Jensen's argument relates to the *where*. Furthermore, trawlers cannot use mobile phones as they typically fish too far out in the ocean, beyond reach. They use radio. The landing centers where Jensen did his research are mainly trawler harbors, so mobile phones are not used for the purpose he proposed. Perhaps radio is indeed used to determine market prices. Even in the north it seemed to us that prior arrangements force boats to land where those arrangements hold. Thus, even large trawlers do not have as much freedom of choice selecting which harbor to sell their fish as Jensen suggested.

No research was done by Jensen to determine whether other ICTs had been used prior to the arrival of mobile phones to determine market prices. No comparison was made to determine why specifically mobiles made the difference. Jensen merely took the false correlation of increased mobile sales as the causal factor and built his case on this unsupported foundation.

Finally, fieldwork by Steyn and Das (2015) found no evidence from conversationalists that mobiles are used to determine market prices.

9. FREEDOM TO CHOOSE LANDING SPOTS

Jensen's case is based on the assumption that fishermen have freedom of choice to land their fishing craft anywhere they wish. Several counter-arguments are presented to show that cannot be the case.

9.1 Kerala Marine Act of 1980

Fishing craft movements are regulated by law, which means there is not the freedom of movement as suggested by Jensen. The Kerala Marine Fishing Regulation Act (1980) was introduced to protect traditional fishermen. The scope of the law applies among other matters, to the size of fishing vessels, vessels allowed in certain areas (or zones), fish species that may be caught and the periods during which they could be caught, as well as the use of type of fishing gear by area (or zone). To ensure that traditional fishermen are protected, all vessels are required to be licensed, while licenses are issued location specific.

Fishing vessels are required to be licensed by area (Clause 7). The movement of fishing vessels are controlled by this act: ”Information to be given to authorized officer about movement of fishing vessels.- Where a registered fishing vessel moves from the area of one port to the area of another port, the owner of such fishing vessel shall give information to that effect, in the prescribed manner, to the authorized officer by whom such fishing vessel was registered and also to the Port Officer having jurisdiction over the area whereto such fishing vessel has been moved." (Clause 10). It is not entirely clear whether this movement refers to changing the port of registration, or to docking at another port. Our fieldwork data suggest this relates to docking at other ports.

In 2013 an Amendment was published by the Kerala Government (Kerala Marine Fishing Regulation Amendment Bill). The purpose of this Amendment is only concerned with streamlining the registration of fishing boats, which means all the other clauses of the 1980 act are still valid.

Boat movement is regulated by law, and not as free as suggested by Jensen. The date of the 1980 Act is significant. It was published 25+ years before Jensen's paper. Boats are licensed by port. The Government of Kerala subsidizes fuel for fishing boats, but such fuel is available only at the port of registration. This means that a boat fueling at another landing center does not qualify for the subsidized fuel, and has to pay more. Steyn and Das (2015) found that this was one reason given by stakeholders why they could not go to landing centers other than their home base, even if market prices might be better. The additional cost for fuel would not be covered by the additional margin of profit. So even if boats could go to any market of their choice, such logistic prohibitions would stand in their way.

9.2 Fishing Zones

The argument contra Jensen runs as follows: if boat movements are restricted to fishing zones by boat type, they do not have freedom of movement regarding catching fish. If true, Jensen's conclusion is false.

The regulation of boat movements is based on certain zones for certain classes of boats. As determined by the Kerala Marine Act, vessels are restricted by type to the zones in which they may fish. Formal zones are determined by ocean geography and ecology, which in turn determine the fish species found in those zones (details in the companion website).

These formal zones are not be confused with the *catchment zones* Jensen mentions. He claims that "On observing their own catch, each fisherman updates their assessment of the state of their catchment zone..." (2007: 884). His zones relate to his own theoretical constructs, not to the formal zones of Kerala fisheries.

Fisheries literature refers to three kinds of zones: maritime zones, Coastal Regulation Zone (CRZ) and potential fishing zones (PFZ).

Maritime Zones are areas protected by Indian law and concern matters such as the movement of foreign vessels and the Coastal Regulation Zone (see e.g. ICSF - Fisheries and Fishing Communities in India, 2014). These zones follow geographical features, such as the contours of the continental shelf. The Kerala Marine Act restrict the types of craft that may

fish by zone. For example, trawlers may not fish on the coastal shelf close to the shore. As the oceanography differs along the coast, trawlers need to travel much further from the shore in the north than in the south. Fish species differ according to the ocean ecology and bathymetrics. This means that only trawlers fish in the deep ocean, catching different fish species than caught by *vallams* and *kattumarans*, which fish in the shallower coastal waters.

A PFZ (potential fishing zone) is an area where large shoals of fish are observed using satellite imaging (Kerala State Remote Sensing and Environment Centre, 2012). These zones are dynamic and change according to the locations where shoals migrate and are observed. But if an observed shoal moves into a CRZ for which a boat is not registered, no fishing is allowed.

Perhaps Jensen's zone refers to PFZ, but he does not say.

The existence of legally defined zones along the Kerala coast regulate where certain types of craft may fish, and place a restriction on the freedom of boat movements. As different fish species are found in different zones, this further implies a diversity of types of fish harvests, which in turns implies that markets are not homogeneous as products vary according to the sub-regions and the types of fish boats bring to the markets. Jensen assumes homogeneous markets – except for pricing.

The existence of these zones imply that boats do not have the degree of freedom assigned by Jensen.

9.3 Landing Rights

Contrary to Jensen's claim that fishermen can land at any landing center of their choice, where market prices are better, craft require permission to land at centers other than their home bases - given one interpretation of Clause 10 of the Kerala Marine Act. Although landing at other centers is possible, especially in cases of poor weather, even when landing at other centers, fishermen may not be allowed to sell their fish at that center. This is most strictly applied in the far south, especially at Vizhinjam. Vizhinjam is only about 8Km south of Valiathura, as the crow flies. Yet, Valiathura fishermen are not allowed to sell their fish at Vizhinjam, which is in the same city district. Steyn and Das (2015) report a conversation with a boat owner who also owns an auto-rickshaw (or tuc-tuc) and informed the authors that he is not allowed to sell his fish in Vizhinjam. The reason he bought a tuc-tuc is to transport his catch from Vizhinjam to his home base, Valiathura, when weather forces his boat to land at Vizhinjam. Otherwise he uses his tuc-tuc as a taxi. The authors could not determine whether this custom is applied Kerala-wide, or only in Trivandrum.

In addition to landing rights, relations between boats and stakeholders at the landing centers are such that even if there were no Kerala Marine Act, boats would not have freedom of choice where to land. Auction agents (*tharakan*) at Thoppumpady in the north informed us that it is on rare occasions that boats would dock at other harbors. The agents advance substantial advances for boat operation, and expect the boats to return to their landing centers. In both the south and the north boat movements are restricted.

Another point of importance concerns trust. A large number of fishermen informed us that they would not land as landing centers other than their own as the do not know the people at the other sites, and could not trust them. The prefer their home base where they have trusted people networks.

10. Systems Diversity

Kerala fisheries is not homogeneous, but shows typical characteristics of the complexity and diversity of human systems. The points presented here indicate this diversity, and relate to Bunge's environment requirement for understanding a system. Jensen on the other hand does

not account for the possible diversity of the Kerala fisheries as he assumes a monoculture of fisheries with homogenous market behavior. He makes the sweeping statement that mobiles benefit the fisheries, Kerala economy, and then overgeneralizes to global markets.

10.1 North and South Coasts

Another argument contra Jensen runs as follows: if the fishing systems of the north and south have different properties, conclusions based on one region might not apply to the other region. In this case, if Jensen's claim is indeed true, the characteristics of most landing centers all along the Kerala coast are the same; the economy is the same, the culture is the same, and so forth.

However, the north and south coasts of Kerala are very different. Findings that apply to the north coast might not, and in fact mostly do not apply to the south coast. A literature study, as well as our own fieldwork clearly show up the differences. Photo evidence showing the difference is also presented on the companion website (Steyn 2014).

The north coast has a larger population (33,387,672 or 42%) than the south coast (8,058,930 or 34%), but the south has slightly more active fishermen – 52% (75,247) as opposed to the north coast's 48% (70,149). There are more fishing villages (55.9%) and fish landing centers (54.5%) in the north, as well as more fishing craft (51.6% or 11,238). However, the regions differ according to type of craft, and by fishing zones. The Kerala Marine Fisheries Census of 2010 lists 187 landing centers, but there must be many more as we have come across quite a few not listed, while many more spots of landing are on beach sand. We suspect there must be quite a few more than 200 locations in Kerala where boats land to sell fish.

Most muscle powered craft are found on the south coast (4,583 or 78%), while 78% (3,661) of mechanized craft are found on the north coast. Muscle powered boats do not veer as far from shore as motorized craft, which means that different species of fish are typically caught in these different regions. This also means that the north and the south differ in catch size as mechanization enables larger catches at a time.

The north and south differ along the following lines, as discussed by Steyn and Das (2015).

- Population size
- Craft type
- Weather
- Coastline
- Oceanography
- Bathymetrics
- Fish species
- Market customs and infrastructure

By logic alone, without considering results of conducted fieldwork, it is clear that one cannot generalize from the characteristics of northern markets to apply to southern markets. And certainly one cannot generalize from the particular features of a few landing centers in the north of Kerala, and apply them globally not only to fisheries, but to all types of markets, as Jensen has done in his conclusion (2007: 919, 920). If Jensen had claimed that mobiles made a difference to the economic welfare of a few landing centers in northern Kerala, regardless of the other flaws, his paper would not have required so much attention. But his overgeneralization is a matter of concern, especially as so many in ICT4D literature follow his findings blindly.

10.2 Diversity of Kerala Fish Markets

Fish markets do not have homogeneous processes and customs. Physically they differ regarding sophistication, property size, buildings, and amenities. The dominant types of craft differ, and consequently the dominant fish species sold at different markets differ. Market prices as well as catch sizes differ, with a marked difference between the far south and northern markets. The significance of different role players and stakeholders differ. A large number of markets are held on the beach sand, while others have permanently constructed docking bays and buildings in which auctions take place. More details on these differences are offered by Steyn and Das (2015) and on the companion website (Steyn, 2014).

Although Jensen conducted his research at 15 landing centers, they are all based on the more affluent north, and he seems to have focused on the more formal markets that receive deep ocean trawler craft. But even in the north there is more diversity among fish markets than implied by Jensen. For example, Chavakkad (Thrissur District) has a beach market supplied by *vallams*, not trawlers.

If fish markets were homogeneous across Kerala, it might have been possible to draw state-wide conclusions based on research at a few affluent markets. However, given the diversity of fish markets along several dimensions, one cannot draw generic conclusions, no matter how large the sample size was within the 15 centers of Jensen's research project. Generalizing conclusions from 15 centers Jensen mentioned, but as we have seen, only at most 5 with fishermen that sell elsewhere, to the more than 200 landing centers in state of Kerala, and then to global markets is a very long logical jump, and suffers from the logical error of over-generalization.

10.3 Fishing Craft

Several arguments relating to craft support the case against the case in discussion.

The properties of different types of craft differ. Properties include the distances different types of craft can travel, the method of propulsion, the method of harvesting fish, the type of fish (i.e. species) caught differ (depending on the regional ecology of the oceanography). A long list of conclusions can be drawn from this, such as that muscle-powered craft will not travel as far as engine-powered craft; that there is a correlation between boat size and catch size; that mechanized net gathering allows for larger net sizes, resulting in larger fish harvests than hand-drawn nets; and so forth. If true, these craft properties imply that the fishing industry is not homogeneous, so conclusions based on some landing centers cannot be generalized.

Quite a bit of detail on craft is presented here. The reader might wonder what the relevance is for the argument. The point of the detail is that disregarding all the other points of the criticism, by considering only the types of craft there should have been doubt about Jensen's claims. The complexity of the craft subsystem should indicate that researchers should not conduct research on social systems in a reductionist fashion. Had Jensen consider the variety of craft and their characteristics, he should have known better than to extrapolate generals from isolated particulars.

Different types of fishing craft catch different species of fish, and are restricted to fishing in fishing zones regulated by the Kerala Marine Act. This means that the catch of different craft differ. Given the quantities of different types of craft, it implies different sizes of catches at different landing centers, and thus different potential income. It further implies different markets. For example, the catch of a deep sea trawler with mechanized nets should logically be much larger than the catch of a *vallam* that fishes about 2km off shore with hand-drawn nets. Some markets are predominantly served by trawlers, others are served by *vallams*. This fact alone should lead to the conclusion that neither the fishermen, craft or the

markets are equal. This is another argument against Jensen that fishermen in general benefit from the best markets.

According to the *Marine Fisheries Census 2010. Kerala.* (2010) there are 21,781 fishing vessels in Kerala, with 51.6% in the north, and 48.4% in the south. The web article *Fishing Craft* (2013) presents a useful summary of the different types of craft. For our purposes the following distinctions are useful. Photo evidence is available at the companion website. There are muscle-powered craft, motorized craft, and mechanized craft. This distinction exposes the following logical constraints. Muscle-powered craft cannot veer as far into the ocean as motorized craft- humans have to row these boats. Hand-drawn nets cannot load as large catches as mechanized netting as human muscle power needs to draw in the nets. Trawlers are the only mechanized craft. *Vallams* are smaller boats, some motorized, some muscle-powered. Their nets are drawn by hand. Larger craft use engines for propulsion, smaller craft use muscle power, although even some *kattumaran* have long-shaft propellers driven by small engines. For drawing nets, large craft, the trawlers, have motorized pulleys, while smaller boats use muscle power. In between the large and small craft are *vallams*, traditionally muscle-powered, but today most often engine powered. But their nets are still drawn in by hand,

In the south there are 4,583 muscle-powered craft, while in the north, 1,301. These craft typically fish very close to shore, and of course also close to their home base. It is highly unlikely that these almost a third, or 6,000 craft (5,884 or 27% of all craft), will be rowed to a better market that is far from their home base.

Among motorized craft there are mechanized craft, meaning that nets are drawn in mechanically, and not by hand. For example, ring-seiner nets are as long as 450m to 1000m, and require mechanized gear for operation. Such nets are huge compared to hand-drawn nets. In the south there are 1,031 trawlers, and in the north 3,661. About 20% of craft in Kerala are trawlers. The catch of trawlers are noticeably much larger than the catch of *vallams* and smaller boats. The fact that there are more trawlers in the north results in larger harvests, implying larger markets, which indeed is the case. There seem to be many more formal markets in the north, also evident by the larger buildings and more energetic activities. Photo evidence clearly demonstrates this.

The *kattumaran*, not to be confused with the contemporary English word *catamaran*, is the most basic craft, and a traditional craft type. It is constructed by tying together two or three logs. Rowing is done with flat planks, and not contoured oars. *Kattumarans* are used by subsistence fishermen. Some *kattumarans* are propelled by a small long-shaft outboard engine. A more rigid boat than the *kattumaran* is also used along the Kerala coast. It is often built with planks, but also with fiberglass, which is much more expensive. Such a boat is called a *vallam*, although some call it a *dhinghi*. They are often propelled by an outboard engine, which is typically removed when the craft is not in use, but some are muscle-powered only. The third major type of boat is the trawler, more active in the north, which has an on-board engine, typically has a cabin and apart from being motorized, its netting system is mechanized.

In 1953 a 10-year process of modernizing Kerala fisheries was introduced, with the assistance of the INP (Indo-Norwegian Project), and of experts from FAO (Food and Agricultural Organization). Mechanized boats were then introduced for the first time. Prior that that, all boats were *vallams* or *kattumarans*.

Along the south coast lower craft technology dominates, with 78% of all muscle powered craft of Kerala found in the south, just under half of motorized craft (44%), but few mechanized craft (22%). Fieldwork by Steyn and Das (2015) reveals that some trawler owners live in the south, but own boats in the north. This means that there is no correlation

between the home location of a boat owner, and the port where it is licensed. Mechanized craft of the Ernakulam district constitute 33% of all Kerala's mechanized craft, and Kozhikode 22.6%. These two districts have more than half of all mechanized vessels.

The outboard *vallam* is much smaller than a trawler. In the south there are 4,929 motorized *vallams*, and in the north 6,246. This totals 11,175, or 51% of all craft. *Vallams* typically fish about 2Km from shore. The fish species caught by these craft thus differs from fish caught by trawlers fishing deeper in the ocean.

Muscle-powered craft, and motorized vallams comprise almost 80% of all Kerala fishing craft. By far the majority of craft can thus not veer deep into the ocean, nor very far from their home bases. This fact alone dents Jensen's argument that fishermen can sell their fish at any market with better prices. Logically, such activity would only be possible for landing centers that are within close enough reach. For muscle-powered boats that means a few kilometers from shore only, typically not further than 2 km. Motorized *vallams* might venture further, but given benefits at their home bases, such as subsidized fuel and known networks, such ventures must be the exception rather than the norm. Jensen implies that it is the norm.

The further south, the lower craft technology dominates, and the further north, the more mechanized craft. As mechanized craft can land larger fish harvests, and are more dominant in the north, the logical conclusion is that larger lots of fish could be sold in the north, and fishermen could earn more. Jensen did his research only in the north. At best, if his case had any merit, his conclusions could apply only to the larger northern landing centers, and certainly not Kerala wide. His further conclusion that mobile phones benefit developing economies is thus void. An analysis of the types of craft and their characteristics alone leads to the logical conclusion that Jensen's case cannot be accepted.

10.4 Role Players and Stakeholders at Fishing Markets

Abraham (2007:10) presents a useful diagram of the fishing supply chain. His diagram does not present all the possible role players or stakeholders involved in the fish markets. Neither does Jensen consider other important role players, as his main focus seems to be on fishermen and agents. Markets are much more complex than any of these two authors suggest. Figure 1 shows the relations between the nodes in the complex system of a fishing market. Specific nodes might not be present at all markets. For example, a knife sharpener may have a role at the beach markets where fishermen or fishmongers need to cut fish (or nets) with sharp knifes, but not at markets where fish is not processed at the market. It should also be noted that roles do not map on a one-to-one basis to individuals. An individual might play several roles. And obviously, several individuals might play the same roles.

Here is a brief list of role players and stakeholders at fishing markets, following Steyn and Das (2015). The many nodes in this social network with different stakeholders, roles and services, indicate the complexity of fish markets at the landing centers as complex social systems. An argument that considers only relations between fishermen and agents, and only the economic benefit of one stakeholder, namely fishermen, does not consider the impact on the other role players.

- **Fishermen**. They are the harvesters and catchers of fish, but they are not necessarily boat owners. Neither are they necessarily the decision-makers about where to catch fish, nor where and when to land their boats. They operate on the production-side, and few are involved on the market-side.
- **Boat owners** are not necessarily fishermen. Anyone with money to invest in a boat can do so. As boats are expensive, ownership is often shared, either in informal trusted networks, or formal cooperatives.

- **Financiers** supply funds for purchasing boats, or for maintenance and running costs. Arrangements regarding interest rates, payback schemes, and so forth can be quite complex.
- **Auctioneers** handle the bidding at markets. Financiers and owners have their own preferred auctioneers. Even after a boat has landed, they would wait for their trusted auctioneer to arrive (sometimes from home) before unloading. Some auctioneers are also financiers, and some even own shares in a boat.
- **Agents**. In some cases at the large trawler markets in the north agents are used, especially for international selling of fish, but also by large bulk buyers based in Kerala. Agents typically have relationships and fixed contracts with bulk buyers and boat owners. These fixed contracts force boats to land at the fixed landing center. We have not come across agents at the smaller markets, not even at the important ones, such as Vizhinjam. Auction agents (or *tharakan*) finance large numbers of fully mechanized trawlers, which then have to return to them, and do not land at other centers.
- **Church tax collectors**. They are found only at Vizhinjam. They collect the tax from the sale of each individual lot directly after the sale, and issue receipts.
- **Bidders**. After landing, fish are divided into lots on which bidders bid. Bidders could be individuals buyers, or buyers who buy on behalf of other parties (including groups of vendors who club together). In the north these lots are huge. In the south lots could be very measly, consisting of literally only a handful of fish. The more affluent bid on the first assigned lots. At some markets the lots are subdivided for another round of bidding. In some cases the second lot is again sub-divided for a further round of bidding.
- **Resellers**. They buy larger quantities of fish, sometimes in bulk, transport their stock to other locations where it is resold at those markets, typically in the interior. The size of "bulk" here is relative. In the south a reseller might "bulk" buy a basket full of fish. In the north several trucks might be needed to transport the bulk stock.
- **Vendors**. They are female fishmongers selling to the public. Some sell their fish right next to the market, either also on the beach sand where the bidding took place, or the nearest road. Others use auto-rickshaws to transport their fish to other locations. They often club together to bid on a lot.
- **Public**. At most markets the public can buy directly by bidding. They are typically regular buyers who buy for household purposes.
- **Carriers**. Except at the poorer markets, paid carriers move the fish from boats to the market in baskets, and after the sale to trucks. They also add ice to the baskets. They are paid for each basket they carry.
- **Ice-men**. At smaller markets these ice men would buy blocks of ice from ice plants, and then crunch the ice at the landing center to be sold to fishermen and to vendors. Ice is used to keep the fish fresh.
- **Knife-sharpeners**. They sharpen knives used by fishermen and vendors for a small fee.
- **Fuel sellers**. They buy subsidized fuel in bulk, and resell to boats at a small profit. Some also have other business interests, such as shares in a boat.
- **Maintenance and repairs**. Fishermen do not fix engines or the boat itself. There are maintenance and repair shops even at all the small harbors.
- **Tuc-tucs, or auto-rickshaws**. At most markets there are informal ranks where tuc-tucs are waiting to offer their services. It is obvious that participants in the markets require transport to get to the markets. At smaller markets, even the more affluent

financiers and owners use tuc-tucs rather than their own transport. Tuc-tucs are also used by vendors to transport their fish to other sites.

- **Other vendors**. At most smaller markets other vendors sell their wares too, such as fruit, vegetables, refreshments, and basically anything that would sell.

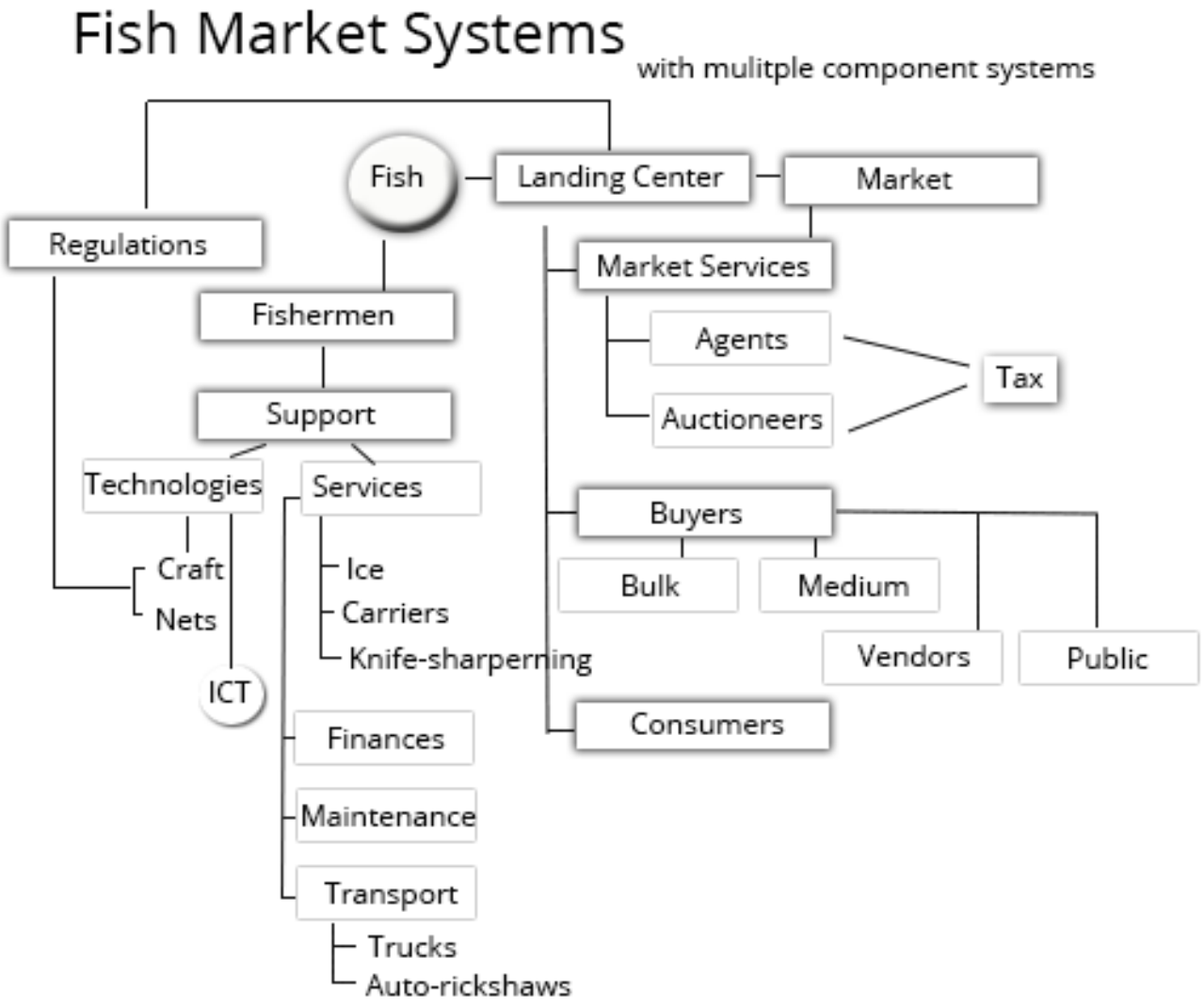

Figure 1. Multiple component systems of the Kerala fish market system

Especially at the smaller and more informal markets, relationships between role players depend on trusted networks. Fishermen would not go to landing centers other than their home base as they do not trust role players at other locations. Mobile phones are indeed used by any or all role players - for personal communications. Regarding the catch by fishermen, and the auctioning of a fish lot, mobile communication could be between a variety of players. But evident from the research of Steyn and Das (2015), mobile communication between fishermen and agents is rare.

The relevance of presenting this long list of stakeholders is that there is a serious economic implication for these players if Jensen is right. All of these stakeholders depend on fishermen landing their fish at their landing center. Imagine a scenario in which, following Jensen's case, all boats speed off to a different market that has better prices. No boat turns up

at the landing center where this long list of stakeholders are waiting in vain. What a disaster!

10.5 Boat Ownership and Finances

The argument for the relevance of boat ownership and finances runs as follows. There is no one-to-one correlation between fishermen and boat financing. Financing includes capital, maintenance and running costs. Financiers or their representatives have decision-making powers over the movements of boats. This includes locations where to land, bearing in mind landing regulations. Thus, fishermen, except if they are also boat owners, do not have decision-making powers on where to land or sell their fish. If this is true, the basis of Jensen's argument that fishermen can land wherever markets are better, cannot be accepted, consequently his entire program falls flat, not matter how much data on market-prices were gathered.

The matter of boat ownership is quite complex, and so are financial arrangements (Steyn and Das, 2015). Jensen implies that fishermen have power of decision where to land, and by implication that they own their boats. The matter is much more complex. Although the Marine Fisheries Census (2010) reports data on boat ownership, it does not distinguish between individual and shared ownership. The report mentions the words "fisherfolk" and "families", but likely as synonyms. An individual, as member of a family, might report ownership of a boat, but that does not imply sole ownership of a boat.

Few boats are owned by individuals. An analysis of the Marine Fisheries Census (2010) shows that of the 21,781 craft, 13,985 (i.e. 55.9%) were owned by fisherfolk. Just over half of boats are owned by fisherfolk, keeping in mind that this does not imply individual ownership. However, only 28% of mechanized craft are owned by fisherfolk; 53.7% of motorized boats, and 61.5% of muscle powered craft. It is interesting to note that 38.5% of the cheapest craft are not owned by the fisherfolk themselves.

Craft are typically owned by informal or formal consortia. Informal consortia might include a number of fishermen, other family members, or any of the other stakeholders, including auctioneers, agents, merchants -- thus, anyone in the trusted circle who has money to invest. Formal consortia are such as cooperatives, which seem to operate on a more legal basis.

Even in cases where fisherfolk own their boats, many cannot afford the running costs and maintenance of their boats. We were unable to obtain exact figures, but impressions from our fieldwork (certainly in the south) suggest that the majority of *vallams* require additional funding as fishing is not profitable enough. There are different models of financing. Financiers typically give advances to fishermen, who are then obliged to return to the landing center of the financier, who typically lives near the home base, and who always seems to be present when the boat lands. Payback methods of loans from financiers take various forms. Interest on the advances for running costs are typically paid back by daily catches, with the bulk of such income going directly back to financiers - at least in the south. In fact, fishermen are not even involved in the market or exchange of money. Auctioneers pay the financiers, who then pay the fishermen their cut. When the catch is small, the financier would select a few fish for private use, deal out some fish for the use of the fishermen, and if anything remains, it is sold by auction. Cases have been observed where the catch was too small for selling, and in such cases debt increases. Money earned is regarded as payback of interest, not of the loan. Loans for major repairs place fishermen in an almost permanent cycle of debt. This sounds vicious. But financiers also look after their fishermen during lean months. In fact, a percentage of income is put away by financiers during better months to ensure some income for fishermen during lean months.

Financiers typically call the shots on landing. They have the decision-making powers.

Our fieldwork found that mobile phone communication between boats and financiers is more about *when* to land than *where* to land. During our fieldwork we found no evidence at all of communication between fishermen and agents. We found that the most frequent communications at the landing centers we visited were between owners or financiers and agents, and between owners or financiers and fishermen. Jensen did not define his term *fishermen*, and implied that fishermen have decision-making powers over their boats. It might be the case that with *fishermen* he meant any of the role players involved in the fisheries industry.

11. CONCLUSION

Jensen's claim that mobile phones are used by fishermen to determine market prices while still at sea could not be corroborated, while a considerable amount of evidence points to the contrary. His question to fishermen about mobile use was ambiguous, while answers received directed his research in the totally wrong direction.

His second mistake was to rely on mass media as his data sources. Then he committed the logical error of *cum hoc ergo propter hoc* by confusing correlation with causation. On these building blocks of an ambiguous question, poor data sources and a logical error, he then overgeneralized findings based on a few, less than five, landing centers on the north coast of Kerala to apply not only to the whole of Kerala, but to the whole world, and extend the conclusion from fishing to other sectors, farming and other producers. If all of this were true, then mobile phones certainly would be technosalvation.

Contrary to Jensen, fishermen do not have decision-making powers on where to land or sell their fish. The basis of Jensen's argument rests on the assumption that fishermen can land wherever markets are better, this cannot be accepted. No matter how much data on market-prices were gathered, or on how many markets have better prices than their home bases, the conclusion is wrong as the broad social system was not considered.

Perhaps the most interesting finding of this paper is that different research approaches resulted in very different results. Although interviews were conducted by Jensen, his main method was the rational analysis of market data against the backdrop of particular economic theory. Our own research included literature research covering all relevant themes, along with fieldwork based on observation and informal conversational interviews – thus an inductive, exploratory method. One would expect that even by using this different tool set, we would be able to find data to corroborate Jensen's findings. That would serve the purpose of corroboration by triangulation. One would have expected that our research (as well as that of Sreekumar, and of Srinivasan and Burrell) should have confirmed Jensen's findings. They did not. Jensen is wrong on many levels. Fishermen do *not* use mobiles to find better market prices and sell their fish there.

On a higher level of criticism, fish markets as a socio-economic system consists of several sub-systems and a network of role players. and stakeholders. Such systems should be researched as wholes, or if the focus is on one of the subsystems, at least the nodal connections between the different subsystems should be considered. Reduction does not offer useful answers for complex systems. Economic universals, such as selling and buying have local cultural variations. If this point of variant local contexts is accepted, it follows that considering only freedom of choice and economic welfare, achieved by some technology (mobiles in this case), results in a poor understanding of complex entities such as fish markets. They are not homogeneous, meaning that conclusions reached on minimal aspects should be suspect on logical grounds alone - even without considering any other research on the same topic. In more simpler terms, just the logic of Jensen's paper is suspect, and researchers in ICT4D should not have accepted the validity of his conclusions without scrutiny. Even without the findings of later research (Sreekumar, Srinivasan and Burrel, Steyn

and Das), ICT4D literature should not have blindly accepted such conclusions based on technosalvation.

A rational theory approach alone could be misleading. The rational approach assumes the economy is a supra-historical entity with a life of its own. It lives in Plato's world of Forms, and assumes statistical analysis alone is sufficient to understand social endeavors. Jensen's main problem is methodological. As Mario Bunge points out, sociology is socio-topological, not socio-metrical. Sociology (and economics is here regarded as a social and cultural activity) requires that the metrical and numerical approach be supplemented with comparative or topological analysis, and I may add, ethnographic and social systems research. It requires further investigation that includes non-quantitative data. Bunge says: "An exclusively statistical approach to sociohistorical facts, and moreover an approach focusing on the measurement of petty details overlooking the main stream, may be as misleading as a purely qualitative approach" (2009: 277-278). Triangulation and mixed methods are thus important. But perhaps even more important is using methods that account for the complexities of social systems.

All the above could have been forgiven if ICT4D participants and commentators had not been mislead by Jensen's conclusions, for just about a decade now. Had Jensen reported his finding as an analysis of market prices at fish markets in northern Kerala, and presented his formulaic model to apply to the 15 landing centers he visited, actually only the 5 that support his claim, and stopped at that point, none of the resulting consequences would have demanded the necessary level of criticism presented here. His big mistake was that he dragged in mobile phones by the hair, perhaps because mobiles were the fad when he conducted his research. By doing so he committed many errors, misleading many ICT4D participants.

Unfortunately many participants in and commentators of ICT4D fell into the trap of accepting claims at face value without any critical thinking or scrutiny, a claim that has reached mythical proportions. They still do. Recently Brynjolfsson and McAfee (2014) kept this myth alive. It was thus necessary to put this critique in strong terms, even if it is only to serve as a wake-up call for ICT4D participants to not accept any claims about technology at face value.

Irresponsible claims impact on the lives of the poor. Too many promises are made on the basis of shaky foundations, giving hope to the poor - hope that does not materialize and destroys trust in well-meaning supporting participants. A case could even be made that it is immoral to announce that the latest technology are going to turn the battling, poor community into a vibrant first world economy. Such claims regularly make headlines: the salvation lies in the Web, or telecenters, or mobile phones, or more recently, tablets. Who knows what the next fad will be. Meanwhile, the Millenium Development Goals were far from being reached, after many years of promises and hope. Societies are too complex to be changed with simplified, easy solutions and plans based on particular ideologies.

The myth that mobile phones improved the economic welfare of Kerala fishermen must be buried and forgotten – except to serve as an example of how research in complex social systems should *not* be conducted.

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