Friction in the Oil Business - Bird Eyes View of the Technology Solution Space and the Research Agenda in the Used Cooking Oil Industry

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Abstract

Used cooking oils overuse and improper disposal is a problem with grave health and environment consequence. Worldwide and also in India Government enacts well intentioned rules and regulation but its implementation and compliance are far from what is desired. The issue of noncompliance has many underlying factors. The factors are connected with awareness, attitudinal, financial, and behavioral of aspects of the stakeholders. A non-alignment among all the above factors and also among the stakeholders is creating friction in the reverse logistics value chain of the used cooking oil. The stakeholders are generators of the used oil, the aggregators, the processors and the government. The paper conceptualizes a helicopter view of the problem, the stakeholders, the solution space and the technology as a glue to reduce and eliminate the friction. The main suggestion is a technology driven reverse hyper delivery UCO model (on the lines of home collection services offered by the Pathology services). This model would be successful if all the stakeholders are aware and positively inclined to solve the problem. To ensure the success a Multistakeholder study is required to understand the drivers and barriers of the reverse logistics in the used cooking oil value chain. The paper presents an overview.

Introduction:

Edible oil is an essential ingredient of the Indian food preparation. Large quantities of oil are used for deep frying food item and shallow frying is just to bring that additional aroma to the food. However, branded as a potential threat to human health if it is continued to be used in preparation of food and also threat to environment if it is not recycled. During the deep frying, the oil is brought to boiling stage and remains in this state till all the items are fried and the oil begins to polymerize. It is only after this state and by observation the oil is discarded. It is presumed that many big hotels and restaurant generate large quantities of UCO and is disposed of either through notified aggregators or sell it off to smaller food joints who keep reusing it for food preparation which is unhygienic and unhealthy for human consumption.

It is essential to monitor the quality of vegetable oil during frying, because it is needed to safeguard the consumer health. TPC is an indicator of the oil quality during the cooking period. FSSAI has fixed a limit for TPC at 25 % beyond which the vegetable oil shall not be used. Cooking Oil having a TPC above 25% cannot be reused and shall not go into the food chain again. Such UCO can be used for production of biodiesel and soaps.

Significance of the study:

Although the technology to produce biodiesel via waste cooking oil is well developed, there are other factors constraining the growth of waste oil refining industry. These are lack of raw materials and supportive policies. Although considerable work concerning recycling modes of waste cooking oil to biodiesel conversion is scarce. Existing studies concerning reverse supply chain of waste cooking oil mainly focus on problems regarding recycling modes of kitchen waste [19, Wang L, Liu YZ. 2009], reverse logistics management models (2011,Zhang YM, Huang GH, He L.), route planning for collection of waste cooking oil (2013 Ramos TRP, Gomes MI, Barbosa-Póvoa AP.2), economics and assessment of productive efficiency of refining biodiesel from waste cooking oil (2013 Kelloway A, Marvin WA, Schmidt LD, Daoutidis P., Kagawa S, Takezono K, Suh S, Yuki Kudoh.), optimization and distribution of the reverse supply chain (2013 Lam HL, Ng Wendy PQ, Ng Rex TL, Ng Ern Huay, Abdul Aziz Mustafa K, Ng), subsidies and regulation policies for the waste cooking oil to biodiesel conversion (2007, Tsai WT, Lin CC, Yeh CW), (2012 Zhang HM, Wang QW, Mortimer SR. ,2013, Liang S, Liu Z, Xu M, Zhang TZ) and impact of subsidy policies on the profitability of biodiesel producers and the recyclers under the recycler take-back modes (2014 Zhang HM, Li LH, Zhou P, Hou JM, Qiu YM). However, so far, there are very few studies in the Indian context.

Methodology of the study:

The study is a review of existing publication. The paper was selected by using, waste cooking oil, used cooking oil, reverse logistics, technology in reverse logistics keyword.

Discussion on the exploration:

The discussion will list down the levels of problems, The stakeholders and the problems they facing, the solution being espoused in literature and finally the technology used is discussed.

Levels of problem:

- An understanding of the ISM approach reveals that vehicle access problems, lack of processing technology, inconsistent supply quantity and inadequate production facilities are the top-level barriers. These are the barriers which are being influenced by lower-level barriers.

- The second level barriers lack of collecting centers and poor-quality characteristics; and

- Third level barriers – Lack of Storage Space and lack of Knowledge are the operational level barriers that are most required for the effective operation of Biodiesel production from waste cooking oil.

Stakeholders and the associated problems:

Different stake holders have different drives and inhibitions. A variety of solution would be required to solve the problem.

Stakeholders	Barriers
Home kitchen	Un-aware of the health and environment problem
	Un-aware of the mechanism develop to collect the used cooking oil
	Aware but not keen to take extra efforts and get inconvenienced
Commercial kitchen	Un-aware of the health and environment problem
	Un-aware of the mechanism develop to collect the used cooking oil
	Aware but not keen to take extra efforts and get inconvenienced
Aggregators	Optimizing the collection mechanism to maximize profit
	Pilferage and diversion of the of the Used Cooking Oil for unintended an undesirable use
Processors	Competition from alternative use of the UCO
	Unsustainable procurement price of the UCO

Table 1

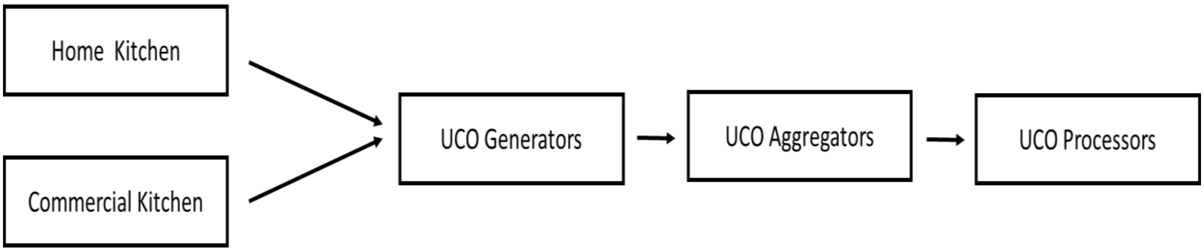

Figure 1

After looking at the sparse literature. The following list of solution has been tries and these should be tried in different context in tandem so as to get some meaningful collection of UCO.

1. In some countries municipalities are obliged to set up the necessary system for collecting used frying oils from households. They initiate waste oil collection campaigns to inform and encourage the public and to collect and dispose of waste oils safety.

2. Initiate some interesting and rewarding campaigns to promote recycling behavior. Some of the campaigns were to 'bring a liter of waste oil and take a bar of soap', bring l

of waste oil and take a pack of washing detergent', and 'bring a liter of waste oil and take a liter of cooking oil'.

3. The fact that the participants do not have the necessary awareness and care despite the higher education levels shows that the curricula on environmental education in schools is inadequate and cannot create the necessary sensitivity and address the current environmental problems.

4. In addition, occasional public spot announcements in the mass media work as a 'reminder' than 'educating' people.

5. The current training mainly focused on children should be extended to include young people and adults. The projects should be prepared by involving the local community and the support of the community should be sought at every stage of the implementation. Each stage of the project should be reported, and the public should be informed of the progress made. People who see positive results will have a more positive attitude and behaviour.

6. Current promotions for solid waste collection should be extended to include liquid waste collection.

7. Ownership model in the recycling business: There are three types of well-defined recycling modes, third party take-back (TPT), retailer take-back (RT) and manufacturer take-back (MT). The modes are shaped by government regulation and/or incentives provided, and both of which have a direct impact on the recycling rates and profitability of biodiesel enterprises. Hence, selection and successful implementation of an appropriate recycling mode can benefit the waste cooking oil to biodiesel conversion.

8. Initiatives for cooking oil waste recycling exist in different countries around the world and they vary depending on the way they have been organized over time. Some practices that worth mentioning were found in Brazil, Canada, Germany, South Africa and Spain.

9. In Brazil, the most important initiatives are concentrated in São Paulo (Ecóleo and IT) but other networks are being formed countrywide. Some small and medium sized companies have also formed their own networks of cooking oil waste recycling in the MRSP. Giglio, Dajac, Lyrium and Hipala, that are associated to Ecóleo, are among them. These companies are organized as independent collection networks having also interfaces with micro-networks represented by dedicated partners (Ruiz et al., 2015). Other Organizations such as Trevo (an independent NGO not connected to Ecóleo) as

well as Cargill and Bunge (huge producers of edible oil) also play important roles in the collection of cooking oil waste, but due to difficulties in getting information about them, only sporadically they will be mentioned throughout this article.

10. In the Canadian case, one important cooking oil waste recycling experience is reported in the Edmonton. According to Bocatto (2016) used cooking oil in this city is disposed of by households on Eco-stations or picked up by recycling companies. Households and small business will be able to dump used cooking oil in the garbage (i.e., in plastic bags) along with other waste and the plant will transform it into bio-fuels.

11. The City of Edmonton has signed a 25-year agreement with a private company – Enerkem – to build and operate a plant that will produce and sell next generation bio-fuels from non-recyclable and non-compostable municipal solid waste. This plant is expected to be the world's first major collaboration between a metropolitan centre and a waste-to-bio-fuels producer to turn municipal waste into methanol and ethanol. There are expectation is that the Enerkem plant represents the first major global collaboration between a metropolitan centre and a producer 'waste-to-fuel' to turn municipal waste into methanol and ethanol (Enerkem, 2013).

12. In Germany, one of the most prominent initiatives is carried out by Bernt GMBH (Oberging/Munich) that collects food remains in kitchens, canteens and restaurants. This company is also a partner of Öli in municipal collecting and recycling used cooking oil and fat for biofuel and energy production. Hostels, canteens, hospitals and clinics, homes for the elderly, kindergartens, snacking among others. dispose of these used wastes in the nearest ecopoints (named Sammelbox in German) where they get a new collection recipient in return. It offers various container sizes for collection to match several times a week or once or twice a month. By processing all these materials this company manufactures a substrate called ProFermo that supplies biogas plants for power generation (Berndt, 2015a, 2015b).

13. In South Africa, de Oliveira (2013) reported experiences of used cooking oil recycling in Cape Town and Stellenbosh. The major recycling network in Cape Town has the Green Diesel company as its 'pivot' and a number of restaurants as it suppliers. This company produces around 300,000 liters of biodiesel per year with the collected used oil. In Stellenbosh, the recycling network reported by de Oliveira (2013) is formed only by restaurants that are located within the campus of Stellenbosh University and its surroundings.

14. In Spain (Polprasert, 2007) refers to an integrated management system for this waste in Spain, but does not provide any detail on it.

Information and Communication Technology Enabling Reverse Logistics: Most lCT systems for reverse logistics have been developed to address needs in a specific sector (i.e. decision-making on different recovery options of returns, designing a product for optimal end of use recovery, etc.) or to cover the reverse logistics requirements of a particular company. Thus, in our attempt to present this area systematically we need to develop a framework of reference first. For that reason, we go back to the essentials of reverse logistics where the recurring theme regarding reverse logistics is that they include processes related to the recovery of products with the objective to facilitate reintroduction of returns into a market. Based on these three keywords, we have identified that ICT systems for reverse logistics have indeed attempted to address one or more of the issues related to:

1. Product data, that is, data regarding the condition and configuration of the returns;

2. Process facilitation, and more specifically supporting operations of reverse logistics; and

3. Redistribution to the market, in particular attempts to consolidate the fragmented marketplaces.

Product data are essential for efficient handling of returns. However, re- turns are plagued by a high degree of uncertainty regarding some of their important attributes (i.e. place of origin, timing and quality standards). Since product data of returns are rarely available, ICT systems have been developed to trace the required information through the systems that were used in the original production phase of each return or to retrieve these critical data through monitoring and, in some cases, reverse engineering methods. ICT systems developed for the control and coordination of reverse logistics processes assist in the decision-making for the recovery options of returns (reuse, remanufacturing, recycling) and support administrative tasks related to returns handling that contribute to more efficient returns management. Upon completion of the required recovery operations, used parts and products need to be forwarded to the market. Interestingly, markets for such parts or products are highly fragmented. In recent years, with the expansion of e- commerce applications, several attempts have been made to consolidate markets for returns through the creation of specialized e-marketplaces. In view of these three main underlying themes, we develop a three- dimensional space (Figure.1) with axes of reference Products, Processes, and Marketplaces, with the aim to systematically analyze how ICT systems process information flows related to these aspects.

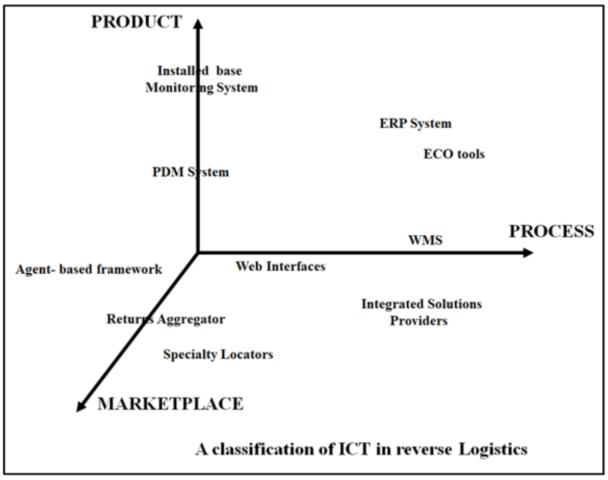

Figure 2

Product Data Management (PDM):

From the reverse logistics perspective, the main contribution of PDM systems is their potential to provide an informational backbone to integrate eco- tools, MRP /ERP systems for returns, and installed base monitoring systems and waste-management systems for returns, and thus to support consistent and updated product data through its entire life cycle. It is necessary to examine what extensions are required for the information systems that interact with PDM systems to update product data. In Table 1, we present the systems that interact with PDM systems and their main functional requirements.

Information systems for returns management	
Information Systems	Functional requirements
Eco-tools	Product design for optimal end-of-life recovery
Installed Base Monitoring Systems	Support extended value-added services for returns
MRP /ERP Systems	Support different recovery options of returns
Waste-Management Systems	Environmentally friendly disposal

Table 2

Installed Base Monitoring Systems:

Product data collection regarding the product's condition and configuration for the duration of its life

cycle is generally referred to as condition monitoring of the installed base, where the installed base is defined as the total number of placed units of a particular product in the entire primary market. For example, the remote monitoring system of OTIS elevators is based on sensors that constantly monitor the critical parameters of the system, and if a problem is detected a message is sent to the OTISLINE, a 24/7 communication center for further action. It is the same center that receives voice communication from passengers in a stalled elevator.

Warehouse Management Systems (WMS):
In In forward logistics, Warehouse Management Systems (WMS) fulfill administrative tracking and handling support. To support the returns process, either special purpose reverse logistics ICT systems have been developed or WMS were extended with proprietary systems to control returns.

Eco-tools:

Eco-tools are analytical tools that provide estimations of the environmental effects of production processes, recovery options, and the end-of-life disposal of products. Based on these estimations, users of eco-tools can examine alternative design scenarios and select a design strategy that is optimal with respect to environmental effects and production costs. Thus, eco-tools promote sustainability of products over their entire life cycle.

Conclusion:

The problem of collection of the Used Cooking Oil in India is less of refining and processing but more of an upstream part of collection of the used cooking oil and channeling into the processing. The problem is unawareness about the bigger problem coupled with apathy and absence of punitive and incentive for the adopter. A multipronged multistakeholder technologically driven optimized solution is what is required.

Limitation of the study: The study looks at limited publication, gives a direction to the academia, practionners, and researchers multidimensional nature of the problem, but is short on the priority matrix. It does not give any direction what should be done first, which intervention will give more outcome at low outlay. A quantification of the awareness level, the quantification of positivity level is what is required from the various stakeholder coupled with the quantification of the government intervention.

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