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ORIGINAL PAPER

An empirical study on opportunities and challenges to commercialize biodegradable products in Udupi and Dakshina Kannada districts of Karnataka, India

Koushik Shetty[1)], Cristi Spulbar[2)], Ramona Birau[3)], K Abhaya Kumar[4)], Darshan M.B[5)] , Petre Valeriu Ninulescu[6)]

Abstract:
This research study aims to understand the opportunities and challenges faced by these families for mass production of biodegradable items. The data for the study was collected by using both personal interview and telephonic interview method. The Snowball sampling method is used in this study; in the first level, the biodegradable product sellers in Udupi and Dakshina Kannada market were contacted. They gave a few primary contacts of product producers; further, these primary contacts gave many references for succeeding interviews. A total of 60 respondents were interviewed for the study. Collected data are tabulated; further frequency tables and cross-tabulation techniques are used in the study to conclude. The study results revealed that the availability of raw materials for Areca nut leaves, Coconut coir and soil based bio-degradable products is abundantly available in Dakshina Kannada. However, the proper technological advancement has not happened to go for mass production. Hence, the cost of production of these items is really high compare to plastic items. For entrepreneurs who are technology ready to produce earthen pots and creeper baskets, Udupi and Dakshina Kannada could be a good destination.

Keywords: *customer behaviour; sustainable development; biodegradable product; cross-tabulation techniques; Snowball sampling method; plastic usage; carbon emissions.*

[1)] Mangalore Institute of Technology & Engineering, Moodbidri Mangalore, Department of MBA, Karnataka, India, shettykoushik957@gmail.com.
[2)] Department of Finance, Banking and Economic Analysis, Faculty of Economics and Business Administration, University of Craiova, Craiova, Romania, cristi_spulbar@yahoo.com.
[3)] University of Craiova, Doctoral School of Economic Sciences, Craiova, Romania, ramona.f.birau@gmail.com.
[4)] Department of MBA, Mangalore Institute of Technology and Engineering, Moodabidri, Karnataka, India, abhaya.kepulaje@gmail.com.
[5)] Mangalore Institute of Technology & Engineering, Moodbidri Mangalore, Department of MBA, Karnataka, India, darshanvinshya@gmail.com
[6)] Faculty of Economics and Business Administration, University of Craiova, Romania, petre.pregi@yahoo.it

1. Introduction and conceptual framework

Biodegradable products are gaining lots of importance today because of the adverse effect of plastic usage (Kaeb and Dammer, 2020). Biodegradable products have an expanding range of potential applications, and driven by the adverse use of plastics in packaging and the perception that biodegradable products are 'environmentally friendly'; their use is predicted to increase (Baral and William 2020). In the year 2017, the Gujarat State government has established biodegradable packaging for food manufacturing units. Food packaging involves the packaging of food products in cans, cups, sachets, bottles, etc. It helps to prevent product deterioration, retain the beneficial effects of processing, extend shelf-life, and maintain or increase the quality and safety of food (Nolan, 2002). India is encouraging the use of sustainable food packaging materials due to rising environmental concerns about carbon emissions, increased health awareness, and waste reduction targets. Naeem et al. (2021) argued that air pollution represents a major factor affecting health conditions in emerging countries considering the impact of global climate changes.

Qaiser Gillani et al. (2021) suggested that the concept of healthy environment acquires a concrete dimension in the context of healthy society (population) but also in the case of sustainable development. Many foods and beverage companies such as Chai Point are introducing sustainable packaging material. In 2016, Chai Point introduced 100% biodegradable packaging such as food boxes, plates, and cutlery. The packaging, made of bagasse, is the fibrous matter that remains after sugarcane stalks are crushed to extract their juice (Song et al., 2009). Suhan et al. (2022) examine the linkage between consumer and brand as emotional attachment for the case of Kerala and Karnataka from India.

Nayak et al. (2021) highlighted the importance of economic growth in the context of emerging countries such as India. Karnataka is a rich and beautiful State with a varied geographical environment and natural resources. In particular, Coastal Karnataka is blessed with the timely monsoon in these districts, due to this reason crops like coconut, paddy, cocoa, pepper, rubber, and Areca nut have become the major crops in the coastal district (Department of Agriculture, 2010). After the Indo Bangla partition, the supply of Areca nut was not sufficient for India's self-consumption that showed a great spike in the areca price graph in India. That was the time where farmers of coastal Karnataka started switching from traditional crop paddy to Areca nut. But later due to globalization the price of Areca nut in India stabilized, still areca is a profitable crop for farmers of Dakshina Kannada and Udupi districts of Karnataka. Today in state Karnataka 1, 84, 52,000 hectares of land are used for areca plantation particularly 65% percent of this number is from the coastal districts of this state. Traditionally in Dakshina Kannada and Udupi, a small quantity of areca leaf was used for agricultural safety items production purposes namely (Muttale). However, today the use of such natural resource-based products has come down in rural Dakshina Kannada and Udupi.

Much later people started manufacturing areca leaf-based plates particularly for heavy crowed functions in temples and Kambala. The reason for such usage was to avoid plate washing jobs. Secondly, the product areca plates are made out of a biodegradable item and in comparison, to banana leaf this product very stiff and perfect substitute for steel or plastic plates. Use and throw plastic plates are generally used by travellers or tourists, which is not a biodegradable product. Dakshina Kannada and Udupi are great tourist destinations too because of the popular holy places and beaches in these districts. However, the products of areca leaf-based products are just confined to

plates; there are many more products that can be produced out of areca leaves. Further areca leaves based plates can be used even by the tourists as this is an environmentally friendly product. This Areca nut and areca leaves' background necessitates a specific inquiry about opportunities and challenges for diversified and mass areca leaves based products in Dakshina Kannada and Udupi districts. According to Ullal et al. (2021) consumers from North India perceive themselves as being more independent, compared to the others from South India which relies on social integration in families and other social groups.

In the major crop list, agricultural product Coconut is not excluded for Udupi and Dakshina Kannada districts. In the coastal districts of Karnataka, 33,537 hectares of land is used for coconut plantations. Central plantation and coconut research institute (CPCRI) is located in the very next district of these districts that are in Kasargod, Kerala. This institute is trying hard to develop few products from Coconut coir, these products fall in the list of biodegradable products. Coconut coir made ropes are not new for people in this region; this product was used by the residents for all types of jobs. However, the plastic ropes and rubber ropes have killed the demand for these biodegradable products. Even today for festivals like Kambala, tug of war coconut coir made ropes are highly preferred. Few families are into this coir rope manufacturing business. These businesses were started by their ancestors to meet the local demand. However, these families have not seen a very big success, few of them have stopped and few of them still just satisfying the local demand. However, these products are in demand today because people are aware of the side effects of plastic made ropes or rubber made ropes. Hawaldar et al. (2020) revealed that agriculture is a main sector in India and has an important contribution to stimulate economic growth and on the other hand to diminish environmental degradation. In this regard, it is necessary to conduct a study to understand the challenges of these families to commercialize this production on a large scale.

One more wing of biodegradable products that were widely accepted in Udupi and Dakshina Kannada district was bamboo or creeper pots. The raw materials for these products were abundantly available in these two districts because these two districts were blessed with the Western Ghats on their borders. Even the districts had very good forest-based resources like bamboo and strong creepers. Replacement with plastic did not exclude this segment too. The cost of production of these bamboo or creeper baskets is too high, it is because of the 100% manual job and very small-scale production. Even the life of those plastic baskets is much better than bamboo or creeper-based baskets. However, lots of researches have already discussed the composite material using biodegradable wastes. In this study, we have explored the opportunities for such mass production of bamboo or creeper-based baskets.

Finally, the earthen pots were also widely used in these districts for a variety of jobs. Various other uses were to store the pickle items, to boil the water, to store the water, etc. However, today plastic, steel, and aluminium vessels have replaced these earthen pots. There is a belief that the food prepared and stored in earthen pots are healthy and tasty. This is the reason why today people are going back to earthen pots. However, the makers of earthen pots have already switched to some other jobs or the next generation is not interested in this business. There may be many reasons for such change the income is not lucrative, and again 100% manual job and they have not seen very big success in this business. This study will challenge the commercialization of the earthen pots on large scale.

2. Research methodology and empirical analysis

The problem statement reveales that people are getting educated and aware of the usage of biodegradable products. In India there is a strong history in making and using these products and even today few families are in the production of these items to meet small size local demand. On the other hand, few materials are abundantly available. However, the genus families have not seen very big success in these products. Hence it is worthwhile to make an exploratory study to understand the opportunities & challenges faced by these families for mass production of these items.

The main research objectives of this study are the following:

- To analyze the various sources of raw materials for selected biodegradable products in Dakshina Kannada and Udupi districts of Karnataka from India.

- To analyze the challenges of families engaged in biodegradable products to commercialize their products on a large scale.

This study is conducted in the Udupi and Dakshina Kannada districts of Karnataka. To collect data for this study, the personal interview method was preferred; however, due to COVID 2019 pandemic, data for the study was collected by using both personal interview and telephonic interview method. The Snowball sampling method is used in this study; in the first level, the biodegradable product sellers in Udupi and Dakshina Kannada market were contacted. They gave a few primary contacts of product producers; further, these primary contacts gave many references for succeeding interviews. A total of 60 respondents were interviewed for the study. Collected data are tabulated; further frequency tables and cross-tabulation techniques are used in the study to conclude.

3. Empirical results

The major findings of this research study are the following:

a) *The education level of the respondents* are the following:

Table no.1 shows the education level of the respondents. The majority of respondents are Pre metric that is 80% of total respondents are in the category of Pre metric. Even their children are not well educated many dropouts in high school level and they are attracted to highly paid daily wage jobs may be in construction or agriculture. This is one of the major reasons for the reduction in the production of these selected biodegradable products.

Table no.1: Investigation on the education level of respondents

The education level of respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
	2	10	16.7	16.7	20.0
	3	9	15.0	15.0	35.0
	4	7	11.7	11.7	46.7
	5	5	8.3	8.3	55.0
	6	3	5.0	5.0	60.0
	7	6	10.0	10.0	70.0
	8	5	8.3	8.3	78.3
	9	1	1.7	1.7	80.0
	10	4	6.7	6.7	86.7
	12	4	6.7	6.7	93.3
	15	4	6.7	6.7	100.0
	Total	60	100.0	100.0	

b) *Product of the respondents* are the following:

Among 60 respondents 26.7 percent are in the production of earthen pots, the number of coconut coir rope manufacturers is very less that is 8.3 percent. 38.3 percent of the respondents are in Areca nut leaves plate manufacturing, this segment is using recent technology for pressing process and even the income level of this section is much more than other segments because of the mass production. Remaining 26.7% of the respondents are into creeper baskets production, the education level of these respondents is very poor and the next generation is not much interested to continue this because of the low level of income.

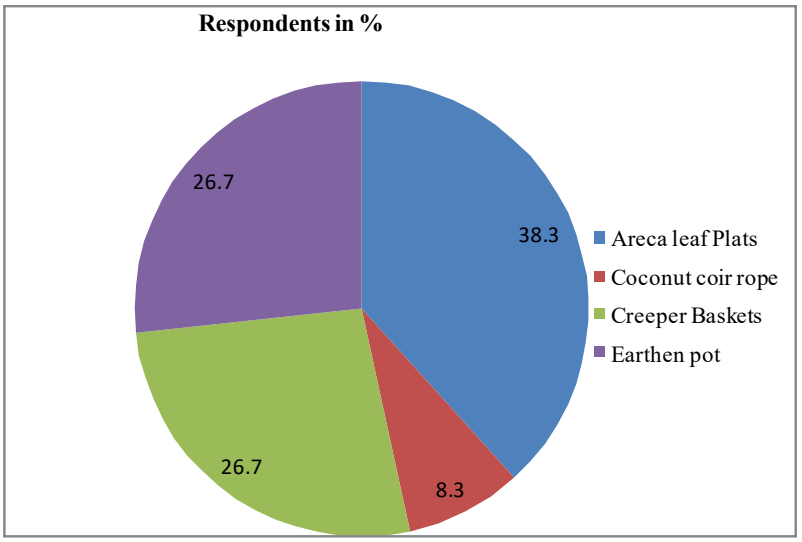

Figure no.1 Product profile of the respondents

c) *Number of years of experience in this business* are the following:

Most of the Areca nut leaf plate manufacturers are new to this business. They started recently because this concept came only after the arrival of a particular technology for such a process. But 61.7 percent of the respondents are continuing their ancestor's business model. The majority of them have not enjoyed lucrative profit or income for their efforts, moreover, for three decades the preference for plastic, steel, and aluminum has reduced demand for their products. Hence many are slowly discontinuing these businesses and looking for attractive daily wage jobs.

Table no.2: Number of years of experience in this business

Since how many years you are in this production?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10	4	6.7	6.7	6.7
	12	5	8.3	8.3	15.0
	15	5	8.3	8.3	23.3
	4	4	6.7	6.7	30.0
	8	5	8.3	8.3	38.3
	Since childhood	37	61.7	61.7	100.0
	Total	60	100.0	100.0	

d) Availability of raw materials is discussed as follows:

The key requirement for the production of these products is the natural raw materials which are discussed in the introduction section. If the raw materials are not available then that becomes the challenge for mass production. 70 percent of the respondents opined that the raw material is abundantly available. 5 percent of respondents particularly Areca nut leaf plate makers have mentioned that the raw material is seasonally available and the supply chain is the issue. Many Areca nut growers use Areca nut leaves as feed for animals or they may use it as material for compost. They also mentioned that the logistic cost becomes more to source from far places. But product makers particularly earthen pot makers, creeper pot makers, bamboo pot makers opined that the raw material is abundantly available in their places.

Table no.3: Availability of materials

Whether materials are available abundantly?					
		Frequency	Percent	Valid Percent	Cumulative Percent
	No	13	21.7	21.7	21.7
	Seasonal	5	8.3	8.3	30.0
	Yes	42	70.0	70.0	100.0
	Total	60	100.0	100.0	

e) Opinion about mass production is explored as follows:

The majority of the respondents opined that the raw material is not an issue except Areca nut leaf plate makers. If the raw materials are abundantly available, whether the product makers are planning for production on a large scale is the question. Table no.4 gives clarity to this question that is the selected biodegradable product makers are not looking for mass production. The major reason what we found was the income that they generate is not lucrative. Secondly, we feel education is the major reason, even the succession generation is not well educated so that business aim or focus itself is not there for the families who are involved in these businesses. Secondly, all the respondents are just satisfying their local demand, they work manually and the technology is not developed so far for such production. The efficiency of manpower is to produce a maximum of one of two pieces in a day, final those pieces are sold for very fewer prices. This makes those families think about other daily wage jobs which will fetch them a lucrative wage.

Table no.4: Respondents opinion about large scale production

Whether you have thought of mass production?					
		Frequency	Percent	Valid Percent	Cumulative Percent
	No	60	100.0	100.0	100.0
	Total	60	100.0	100.0	

f) Why mass production is not feasible?

For this open-ended question, we got mixed and different ten responses. Only Areca nut leaf plate makers mentioned that the demand is seasonal and preferred by only for big temple festivals. They opined that tourists do not prefer these materials just because of the color and even retailers are not promoting much. All retail shops are not ready to display their product in their shops. Creeper and Bamboo basket makers opined that consumers prefer plastic baskets because they are more durable. Earthen pot makers also mentioned that durability is the issue for customers and pricing is not attractive for them. Coconut coir based rope makers opined that raw material is sourced by big factories for bed-making purposes and other sofa and seat manufacturing. Moreover, as we have mentioned above, next-generation are attracted to highly paid daily wage job and income in this business is not attractive.

Table no.5: Investigation on why respondents feel mass production is not feasible

Why mass production is not feasible?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Demand issue	4	6.7	6.7	6.7
	Next generation is not interested	4	6.7	6.7	13.3
	Factories are already sourcing materials	5	8.3	8.3	21.7
	Not lucrative business	4	6.7	6.7	28.3
	Other jobs are profitable	12	20.0	20.0	48.3
	Pricing issues	4	6.7	6.7	55.0
	Seasonal demand	5	8.3	8.3	63.3
	Supply chain issue in areca leaf supply	8	13.3	13.3	76.7
	This size is good enough for local supply	10	16.7	16.7	93.3
	Today people prefer plastic materials	4	6.7	6.7	100.0
	Total	60	100.0	100.0	

g) Whether any of your processes can be mechanized?

For the majority of respondents, this question was not applicable because they have not thought of mass production. However, Areca nut leaf plate makers are already using some technology for heating and pressing process. They are opined that further advancement is not feasible because of the raw material issues and seasonal demand for their products. Even for the Coconut coir rope makers already technology is developed and available in the market. Interestingly retailers opined that the demands for manmade ropes are much more in the market.

Table no.6: Technology development requirement

Which process can be mechanized?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Already mechanized	23	38.3	38.3	38.3
	NA	37	61.7	61.7	100.0
	Total	60	100.0	100.0	

h) Awareness about changing government and customer perspective

The respondents are not aware that the government is promoting biodegradable products and even the customers are slowly getting aware of the side effects of plastic products. 55 percent of the respondents were blank when this question was asked; they do not believe that the government is trying to find alternatives for plastic products. They do not foresee that the items that they are dealing with today will be in demand in the coming days. However, 45 percent of respondents agree that shortly demand for their items will increase and the government is looking for biodegradable products.

Table no.7: Awareness about changing attitude of government and customers towards plastic products

Are you aware that the government is slowly planning to withdraw the plastic products and then your products may be in much demand?					
		Frequency	Percent	Valid Percent	Cumulative Percent
	No	33	55.0	55.0	55.0
	Yes	27	45.0	45.0	100.0
	Total	60	100.0	100.0	

i) What makes your customers purchase your products?

For regional festivals like Kambala and annual festivals of temples, people prefer Areca nut leaf plates to serve the food. They also mentioned that the washing job is not there for Areca nut leaf plates. Creeper and Bamboo pot makers opined that few jobs particularly Hindu temples prefer Bamboo or creeper-based baskets. Earthen pot makers said that few food items are preferably prepared in earthen pots, to store drinking water in the summer season, and to store pickle items people prefer earthen pots.

Why do you think your customers will buy your product when plastic or other substitutes are available?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	For Kambala and Temples	5	8.3	8.3	8.3
	For some jobs specifically, these items are preferred	8	13.3	13.3	21.7
	For some special food preparations	8	13.3	13.3	35.0
	For some special occasions	14	23.3	23.3	58.3
	No response	8	13.3	13.3	71.7
	only rural people prefer	4	6.7	6.7	78.3
	Temple Functions	5	8.3	8.3	86.7
	Washing is not necessary	8	13.3	13.3	100.0
	Total	60	100.0	100.0	

4. Conclusions

Among selected 4 biodegradable items, the raw material is abundantly available for earthen pots, creeper baskets, and Bamboo baskets. However, till today all these products are made by human hands and the suitable technology is not available. Demand for these items is slowly picking up because of increased awareness about the health benefits of these items among customers. The government is also supporting and encouraging biodegradable items to replace plastic items. Due to small scale production, the cost of production for these items is very high, which in turn makes products costly in the market. Suitable technology, which could help with mass production and increased revenue for makers, may make the situation better. If that happens makers of these products may not switch to some other job for better earnings.

For Areca nut leaf-based plate makers already the technology is available, however, due to supply chain issues to source the raw materials makers are not thinking of up-gradation of the capacity. On the demand side, travelers and tourists market has to be captured, in this, the role of retailers and government is vital to promote this biodegradable product. Finally, the Coconut coir rope manufacturers are having tough competition from large scale makers because they use some technology. The raw material is also the issue for this segment because Coconut coir is largely purchased and used by the bed makers and sofa makers. To abbreviate from the above, for entrepreneurs who are technology ready to produce earthen pots and creeper baskets, Udupi and Dakshina Kannada in India could be a good destination.

APPENDIX

Questionnaire

Name of the respondent…….
Place name……
Age of the respondent……..
Education qualification …….
Biodegradable product Name…….
1. Since how many years you are in to this production? ……...
2. What is your monthly turnover from this product? ……
3. What is the core material used in this bio product? ……..
4. Whether materials are available abundantly? .....
5. If yes, whether you have thought of mass production? …….
6. If your answer is yes for question no 5, then is that using any technology? …….. , What process will be mechanised? ……
7. If your answer is no for question no 5, why do you feel mass production is not a feasible idea?
(a) Raw material availability
(b) There is no suitable technology for…… job
(c) Huge capital expenditure
(d) Market/ Demand related issues
(e) Skilled labour issues
(f) Pricing issues
8. Why you think your customers will buy your product, when plastic or other substitutes are available? ……..
9. Are aware that government is slowly planning to withdraw the plastic products and then your products may be in much demand? ……..
10. Finally, whether Panchayath or any other government agency has approached you for mass production? ……

Authors' Contributions:
The authors contributed equally to this work.

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