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Agave fibre extraction: A sustainable agro-based enterprise in dry regions of Karnataka

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Abstract

The extraction of fibre from Agave is the source of livelihood for the habitants of Kurudi Lambani Thanda of Chitradurga district, Karnataka. The present study examines economic prospects of agave fibre extraction for dry land farmers facing weather aberrant conditions. Three out of six processing units functioning in the study region were randomly selected. Enterprise budgeting technique was used to examine the profitability of agave fibre extraction. The study indicated that processors incurred cost of Rs. 8481.03 on extraction of a ton of agave fibre realizing net returns of Rs.14185.64 per ton. The enterprise was found to be economically viable with benefit cost ratio (BCR) of more than unity (2.67). On an average, an Agave fibre extraction unit provided employment opportunity to 24 labour force for eight months in a year. The unit is least affected due to weather aberration and hence can serve as an alternative source of income generation to marginal and small farmers as well as landless labourers in dry regions.

Keywords: Agave fibre, budgeting technique, net returns, BCR

Introduction

Fibres are broadly categorized into natural and man-made. Natural fibres are further classified on the source from which it is extracted as plant fibres, animal fibres and mineral fibres. Man-made fibres are anthropogenic and are further classified into regenerated, organic, inorganic and synthetic fibres. Natural fibres could be spun or twisted into yarn, converted into non-woven fabrics, they are strong, durable and possess attractive colour and luster, have high moisture absorbing capacity and are biodegradable and recyclable. Among the natural fibres, plant based fibres are categorized into soft/bast fibres, hard fibres/structural fibres and surface fibres. Bast fibres comes from phloem tissues in the stems of dicotyledons, hard fibres from leaves of monocots and surface fibres from the covering of seeds, leaves or fruits. Synthetics called as artificial fibres are manmade with an intensive use of chemicals. Plant fibres include seed hairs such as cotton, stem (or bast) fibres such as flax and hemp, leaf fibres such as sisal or agave and husk fibres such as coconut [1]. Fibre extracted out of agave leaves is considered as hard fibres (Udeani *et al.*, 2011) [2].

Agave is a short stemmed half woody plant bearing bunches of long, erect, pointed fleshy leaves. (Sarcar *et al.*, 2015). In Southern India under arid and semi-arid regions, it is widely grown as a hedge plant or live fence to control soil erosion. Andhra Pradesh, Karnataka, Orissa, Maharastra and Tamil Nadu are the major states where it is cultivated. It is a hardy plant, comes up well in regions receiving annual rainfall of 100 to 250 cm. It is commonly called as Kathaalai in Tamil, Rakas Patta in Hindi and Kithanara in Telugu. Agave Americana, *Agave cantala, Agave sisalana* and *Agave vera* CNN are commercially cultivated and proved to be beneficial to farming community [3].

Dry land agriculture is fraught with exacerbating weather aberration. Rainfall being uncertain and erratic has made lives of farming community pathetic in dry regions. In such an aberrant situation, agave fibre extraction stood as silver line for resource starved nature dependent agriculturists and landless labourers. The present study assesses how this venture will provide resilience or shock absorbing capacity to rural folk in the arena of climate change. In the process, efforts have been made to assess the economics of fibre extraction and also to assess the employment and income generation potential of the unit. Agave extraction is traditional practice in the Kurudi Lambani thanda of Chitradurga district. It is extensively being performed by the people belonging to Banjara (Lambani) community residing in the thanda. Traditionally, Agave fibre was extracted by following natural retting process. Two types of natural retting was very common such as water retting and field or dew retting. Natural retting is a preferential rotting process for separation of fibre from the lingo-cellulosic biomass

without damaging the fibre cellulose. Retting involves microbial freeing of plant fibres. The process is highly time consuming requiring two to three weeks. Retting microbes consume non fibrous cementing materials like pectin and hemicellulose and softens the leaves. Fibres can be separated easily when fermentation reaches appropriate stage. The major problem associated with the traditional practice is the chance of over-retting or under-retting having repercussion on the quality of extracted fibres. Hence, retting should be carefully observed to avoid fibre damage. soaking/drenching agave traditionally for 8-10 days (Ashish *et al.* 2015). Traditionally even hand decorticators were used by the rural folk to extract fibre. In this case, leaves were pounded and pulp was scraped away with the knife. It is also time consuming and labour intensive. To overcome all these problems, processors in the locality have adopted mechanical means of separating fibre from agave leaves using raspador machine. Mechanical way of separation of fibre saves labour and time. Processors are finding the acute scarcity of labour both in economic and physical terms in the last decade putting them in hardship to continue with this enterprise. Even after mechanizing most of the operations, this enterprise demands labour. Due to labour predicament, many units have shut their business.

Methodology

Agave is extensively available in and around Chitradurga, Bellary, Hiriyur, Challakere, Imangala, Nayakanahatti, Sanikere and Kalamarahalli regions of Karnataka. In these regions, it is exclusively grown as a live fence. In Chitradurga district, the processing of agave is a source of livelihood for villagers in Kurudi Lambani thanda. The village comprised of 150 families, who more or less depends on agave processing unit for their livelihood. Around six processing units are present in Kurudi lambani thanda of which three were randomly selected for the present study. The data pertaining to capital investment made on the processing unit, procurement of raw materials, labour required to process fibre, other materials required in the processing, yield in the form of dried fibres of different grades, selling price accrued to firm owners were collected using structured schedule. Tabular presentation, simple ratios and percentages were worked out to draw meaningful inferences. Enterprise budgeting was done to examine profitability of agave fibre extraction.

Results and Discussion

Agave processing is location based for which a temporary unit will be set up in regions having sumptuous availability of raw materials atleast for few months. Processors usually identify contiguous villages having sufficient supply of raw materials. From that village, around two to three acres of land will be taken on rental basis to undertake processing operations. Sufficient land space is required to stockpile the raw material, installation of machine, sun drying of processed fibres. The success of unit depends on the availability of raw material. Huge investment worth of Rs. 600000 cornering 79.66 percent of the total investment was made on purchase of tractor (Fig.06). It is quintessential to procure raw materials from neighbouring/ far located villages at the time of non-availability of raw material in the vicinity. The other major investment was on the Raspador machine for performing mechanical decortication of agave leaves (Cheikh, *et al*., 1999). The investment of Rs. 100000 (13.28%) was made on purchase of machine (Table 1, Fig 02). Mechanical process of fibre extraction has become popular as it takes lesser time and requires lesser labour compared to conventional method. In the mechanical decortication, agave leaves are fed to the machine wherein they are crushed and beaten by a rotating wheel set with blunt knives such that only fibre will remain extruding other materials [4]. Decorticated fibres are later washed with water before sun drying. Though, mechanical extraction is not that efficient compared to chemical or enzymatic means of extraction but later are not the plausible option for rural folk. Sickles are used to harvest matured leaves from the plant and also to provide uniform cut to the leaves to enable the process of fibre extraction. Lower leaves standing at an angle of 45^0 to the vertical are cut away from the bole of the plant using sickle. As sun drying is the common practice among the rural folk, it was performed by hanging decorticated and washed fibre material on the iron wire fastened on the erected wooden poles. Tarpaulins were required to facilitate the drying process.

Fig 1: Laborers harvesting Agave leaves and preparing for fibre extraction

Fig 2: Mechanical decortication of Agave using raspador machine

Fig 3: Drying of extracted fibre on strings fastened on wooden poles and removal of extruded wastes

Fig 4: Grading of sun dried fibre

Fig 5: Heap of Agave fibre ready for market

Table 1: Capital investment on agave fibre extraction unit

Particulars	Qty	Rate (Rs.)	Value (Rs.)
Tractor (no.)	1	600000	600000(79.66)
Raspador machine (no.)	1	100000	100000(13.28)
Tarpaulins	2	5000	10000 (1.33)
Sickles (no.)	60	100	6000(0.80)
Iron wire (mts)	20	60	1200 (0.16)
Wooden poles (no.)	200	175	35000 (4.65)
Drums (no.)	2	500	1000 (0.13)
Total			753200

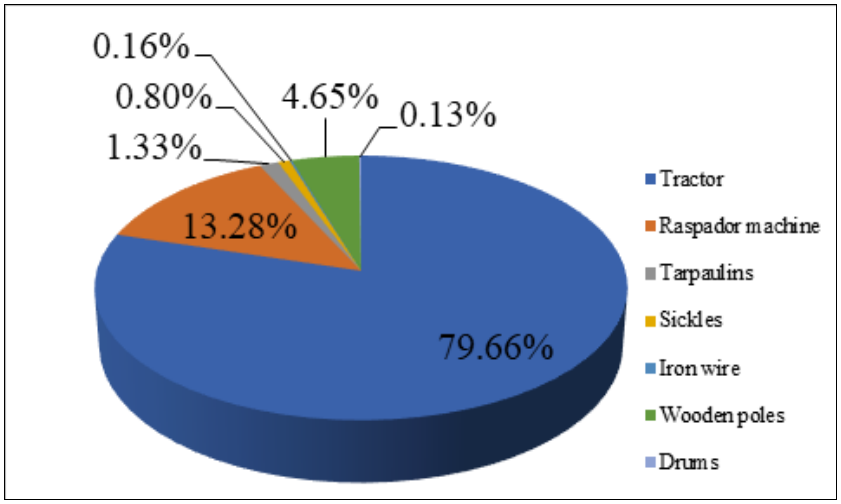

Fig 6: Share of investment on fixed assets in agave fibre extraction unit

Labour use pattern

Agave processing is a labour intensive activity. It is performed for eight months in a year excepting rainy season. Harvesting and procuring raw materials from farmers field was considered as a labour intensive operation demanding 12 labour every day (Fig.:01). For the entire season, 3240 mandays was required at Rs. 648000 to perform this operation (Table 2, Fig.07). Harvesting was performed using sickles. The procured leaves were cut into uniform length using sickles to enable easy feeding of leaves to raspador. Leaves of uniform lengths are stock piled on a stand made out of bamboo poles. In order to perform this operation, 270 mandays of labour valued at Rs. 40500 was required. Later to operate raspador machine, two labours were required every day. In total, 540 mandays valued at Rs. 108000 was required to operate raspador machine. Mechanical processing of agave leaves using raspador separates fibres and extraneous juicy matter. Labour @ two mandays /day was required to collect fibres extracted out of rasping process and one manday to collect extraneous waste material. Extracted fibre was sun dried for three days to remove moisture content present in the fibre (Fig.:03). Optimum moisture content is one of the crucial factor deciding grades of fibres. Fibres are sun dried on iron ropes connected to bamboo poles (Fig.:04 and 05). The last process is to remove extraneous left over in dried fibre and to provide luster to it. On an average, individual agave extraction unit has provided employment opportunity to 24 labour force for the period of eight months in a year. This clearly signals the employment and income generation potential of this unit. Since, agave is a hardy crop it will come up well even in the event of monsoon failure. In the event of monsoon failure, these labour forces fail to get employment opportunity in agriculture. Thus, agave extraction has emerged as a silver line in the lives of these people [5].

Table 2: Employment potential of agave fibre extraction unit

Operations	Qty	Rate (Rs.)	Value (Rs.)
To harvest agave from farmers field	3240	200	648000(53.33)
To place agave on bamboo stand to facilitate feeding to raspador machine after maintaining uniform length	270	150	40500(3.33)
To feed agave to raspador	540	200	108000(8.89)
To collect waste extracted after rasping process	270	150	40500(3.33)
To collect fibre extracted from raspador	540	150	81000(6.67)
To sun dry extracted fibre	540	150	81000(6.67)
To tie extracted fibre into bundles	540	200	108000(8.89)
To arrange for pressing of dried fibres using tractor	540	200	108000(8.89)
Total	6480		1215000

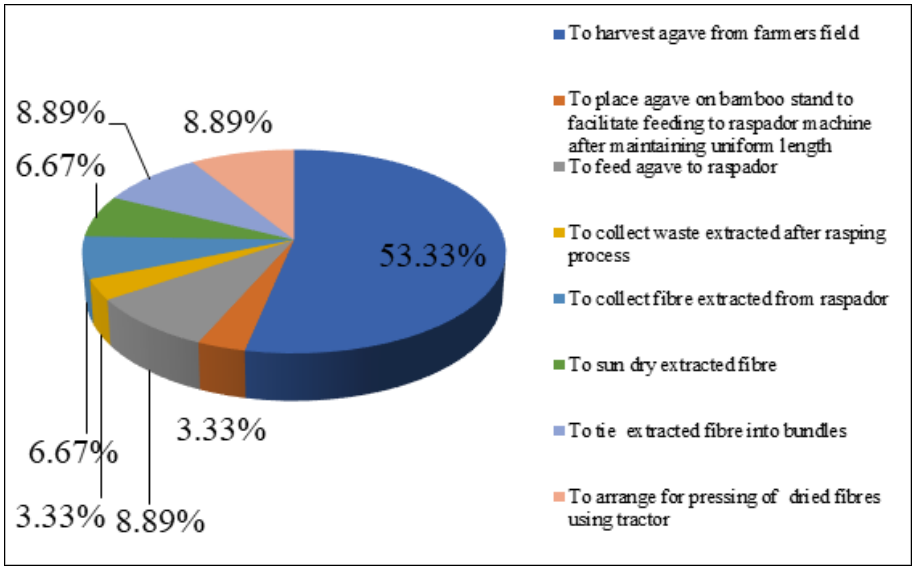

Fig 7: Share of agave extraction operations in employment generation

The expenditure made on raw material came to Rs. 270000 forming 13.10 percent of the total cost. Agave is available on the bunds of the farms as they are grown as live fence by the farmers. They are also available on the either sides of railway line, road sides, river banks etc. Though, they are available in enough quantity and even farmers do not charge for it but processors should have to make expenses towards its collection on labour and transportation. Major chunk of total cost was cornered by labour at Rs. 1215000 (58.95). This reiterates the fact that Agave processing is a labour intensive operation. Diesel is required to operate raspador machine. The expenditure made on diesel came to Rs. 283500 (13.76%). Raspador machine requires regular oiling and greasing for its smooth functioning. The expenditure on oiling and greasing came to Rs. 120000. The other item of expenditure was on annual repairs of machines which worked out to Rs. 16000. The total variable cost incurred on processing of agave came to Rs. 1796500 (87.18%). Fixed cost came to Rs. 264391 (12.82%). The major fixed cost item was depreciation of machine and accessories and interest on fixed capital at Rs. 98200 and 90384. Rental value of land for nine months came to Rs. 18000 @ Rs. 1000 per month per acre. The total cost of agave processing came to Rs. 2060891 (Table 3, Fig.08). The cost incurred per ton of agave fibre came to Rs. 8481.03.

Table 3: Cost of extraction of agave fibres

Particulars	Qty	Rate (Rs.)	Value (Rs.)	Cost per ton (Rs.)
I. Variable cost (VC)				
Raw material including procurement charges (tractor loads)	270	1000	270000(13.10)	1111.11
Labour (man days)			1215000(58.95)	5000
Annual repairs			16000(0.77)	65.84
Diesel (litres)	4050	70	283500(13.76)	1166.67
Oiling and greasing of machines			12000(0.58)	49.38
Sub total			1796500(87.18)	7393
II. Fixed cost (FC)				
Rental value of land			18000(0.87)	74.07
Depreciation			98200(4.76)	404.12
Interest on fixed capital			90384(4.38)	371.95
Amortized establishment cost on tractor and machine			57807(2.80)	237.89
Sub total			264391(12.82)	1088.03
Total cost (VC+FC)			2060891	8481.03

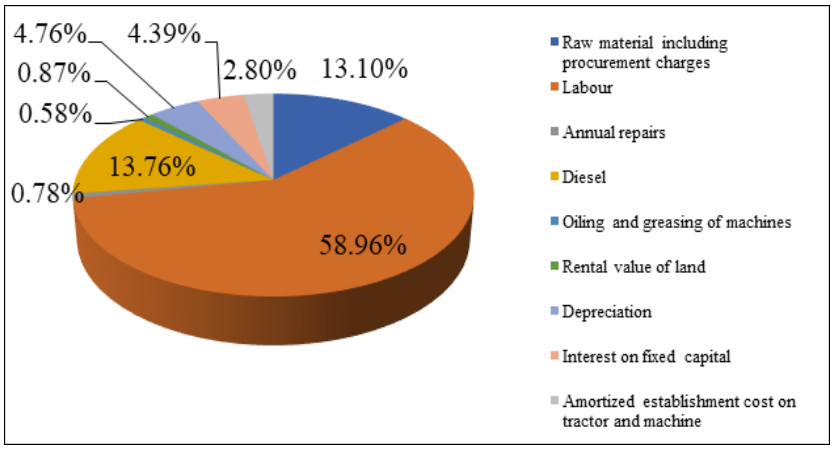

Fig 8: Share of cost components in production of agave fibre

Table 4: Profitability of fibre extraction from agave

Grades of fibre	Qty (tons)	Price (Rs.)	Value (Rs.)
I	54	25000	1350000
II	81	18000	1458000
III	108	15000	1620000
Yield (tons) By product	243		1080000
Gross returns			5508000
Total cost			2060891
Net returns			3447109
Benefit cost ratio Cost Per ton Gross returns per ton Net returns per ton			2.67 8481.03 22666.67 14185.64

Returns are accrued to processors in the form of fibres and juice. Fibres are of three different grades. First grade fibre possesses optimum level of moisture, free from dust and dirt particles, soft and have appearance of white hairs. Third grade fibre possess excess moisture, dust particles and are hard in texture. The second grade fibre possess attributes between first and third grades. First grade fetched highest price at Rs. 25000 per ton followed by second grade at Rs. 18000 per ton and third grade at Rs. 15000 per ton. Around 8 tons of agave leaves were processed every day which yielded around 2 quintals of first grade, 3 quintals of second grade and 4 quintals of third grade. The extracted fibres have huge demand in West Bengal and Maharashtra. The traders from above places procure the sundried fibres from processors. Nearly 6 tons of fibres will be traded once in two weeks to the above mentioned regions. The extracted fibre is widely used for making ropes, cordage, twine, fishing nets, door mats and rugs and the short fibres are used for making mops, brushes. The above are considered to be the traditional uses of agave fibre. Fibre extracted using agave has got excellent properties such as length, strength and luster hence, it can also be used in textile industry for manufacturing of fabrics (Ashish *et al*. 2015) Raspador machine on rasping leaves expel juice having medicinal properties. Two barrels of 200 litre capacity of juice was extracted in the process of fibre extraction every day. The extracted juice is of huge demand in the locality as it possesses insecticidal property. Garlic, Onion, Pomogranite, Papaya, Citrus growers of the regions demand it by offering catchy price. The price per barrel was Rs. 2000. Thus, a processor in the form of by product generates income of Rs. 1080000 during the production period. The total production of first grade fibre for the entire production period came to 54 tons valued at Rs. 1350000, second grade of 81 tons valued at Rs. 1458000 and third grade of 108 tons valued at Rs. 1620000. Thus, processing unit inclusive of fibre and by product generates returns of Rs. 5508000 (Table 4). The net returns generated during production period came to Rs. 3447109. The enterprise was found to be economically viable with attractive benefit cost ratio of 2.67. Though, enterprise is highly remunerative but constrained with supply of raw material on continuous basis and labour force at affordable wages. The net returns accrued per ton after making consideration for all costs came to Rs. 14185.64.

Conclusion

Rainfed agriculture is fraught with climate vagaries. It adversely affects rainfed agriculture. To sustain the livelihood of farmers under aberrant situations, agave fibre extraction has emerged as an alternative enterprise. The unit provides employment @ 25 labour folk per day for nine months a year. Enterprise is not only sustainable but also economically viable reflected in the magnitude of Benefit Cost Ratio of 2.67. The availability of raw material is the major predicament associated with the enterprise. Government should have to take necessary initiatives to ensure its continuous supply. The enterprise benefits farmers through earnings from fibre extraction and Government through export earnings/reduced reliance on imports. Agave yielding natural fibre reduces environmental pollution.

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