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ORIGINAL ARTICLE

A VIABLE MODEL FOR BROOM GRASS CULTIVATION AND MANAGEMENT IN TRIPURA

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Abstract:

Realizing severe decrease in broom grass production in wild and ever increasing market potential, it has become the need of hour to domesticate it in farmer's fields. This can be achieved through sustainable cultivation under agroforestry. Introducing the plantation in a new site has many implications such as suitability of land, willingness of farmers for sparing their own fields, choice of perennial and seasonal but profitable and suitable intercrops and market linkages. The participatory approach adopted at every stage, established a pathway to reach the objectives taking care of all the implications. Extension strategies by using SWOT exercise have been significantly effectual to understand the problems and prospects. The analysis helps to motivate farmers for participatory planning and execution of the On-farm research and demonstration. The observations and experiences from the study site reveal that the practice is much viable (Benefit-Cost Ratio of 6.21) and sustainable. It has a potential scope for extension in Tripura and north-east hill regions of India as well.

KEYWORDS:

Broom Grass, *Thysanolaena maxima*, Arhar, *Cajanus cajan*, Agroforestry, SWOT Analysis.

INTRODUCTION:

Thysanolaena maxima (Roxb.) O. Ktze (Broom grass) is a tall, perennial rhizomatous, tufted grass has solid, smooth and rounded culms with huge and drooping inflorescence. In Indian northeast region, it is considered as multipurpose, non-perishable cash crop. The mature inflorescence of T. maxima is used for making brooms that has sufficient demand in each and every household throughout India. Beside brooms, it is used as fuel, fodder, raw material in paper industry and in the construction of traditional houses. This non-timber forest produce species has a very good potential in generating local employment and can turn into a profitable enterprise, with a potential to enhance rural income with minimum efforts and management. The grass can be successfully grown in the hilly tracts even in the degraded *jhum* fallow lands in the region. It is a multipurpose species which provides brooms, fuel, and fodder and has high soil conservation value. The brooms made out of this grass are more durable than other plants such as *Cocos nucifera* and *Phragmites species*. Its cultivation can also promote the sustainable use of fragile and degraded lands. The productivity of grass depends on quality of planting material (Bisht and Ahlawat, 1998).

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Benefits of Broom Grass based Agroforestry

Tangible benefits:

1. Income generation.
2. Increased livelihood opportunities.

Intangible benefits:

1. Increased soil fertility.
2. Decreased soil erosion.

Broom grass can be propagated very easily through rhizomes during winter and early summer months that can withstand a wide range of agro-climatic conditions with varying soil type. Studies indicated that planting T. maxima substantially reduces water runoff and soil loss from degraded land. Cultivation of broom grass on degraded jhum fallow has good prospect to arrest environmental degradation. In view of its multiple uses, high economic returns with minimum input and availability of large area under abandoned jhum lands, its cultivation will uplift the socio-economic conditions of jhumias and other rural communities in NE Region.

In the study site, the northern region of Tripura, it is found in wild and used to be maintained by local JFMC for collection of flower. In view of remarkably reduction in grass production by approximately 50% (NCE Internal Report 2013), within a period of three years, the farmers were motivated to cultivate the grass in unutilized lands under agroforestry. A design of geometrical arrangements was prepared following participatory decisions on suitably mixing Broom grass with Chilli, Brinjal, and perennial Arhar under agroforestry.

Motivation for Participatory Planning and Implementation:

SWOT analysis

Following the PRA approach, the Strength, Weakness, Opportunities and Threat involved in traditional practice of collecting broom grass from wild and marketing of broom grass in the locality

were discussed with the villagers. Interactions during brainstorming session revealed that this practice had a good potential with abundance. Considering present situation of low productivity and increased demand, the proposed agroforestry model would certainly be beneficial. The mutual consultation resulted in designing the combination of different crops suitable in line with the site-specific conditions.

Strengths	Weaknesses	Opportunities	Threats
1. Can flourish in variety of soils and lands of the locality. 2. Good quality raw materials (1 kg of Broom grass can make 3 numbers of brooms). 3. Yield is also higher as compared to other areas in the state as well as in the region. 4. The policy suggesting it to grow on wastelands and steep slopes will not hamper the practice much.	5. Cost of subsidiary raw material for making broom is very high. 6. Role of middle man could not be eliminated. 7. The profit margin reduces while selling the product in retail. 8. Arranging initial investment is difficult for the local farmers	9. Suitable site conditions. 10. Good quality broom grass produced in terms of flexibility. 11. Availability of wastelands and steep slopes suitable for broom grass cultivation.	12. A good quantity of broom grass is damaged due to squirrels. 13. Fog and rain can spoil the harvested product while drying. 14. Susceptible to termite attack.

Score of Weightage			
Positive attributes		Negative attributes	
S	O	W	T
76%		24%	

SWOT Analysis of Broom Grass cultivation in Depachhera, North Tripura

During the process, it was noticed that the ***broom grass based agroforestry model*** will be much viable particularly in North Tripura, as the grass is traditionally collected from wild. Realizing the strength of the site in Depachhera village under Kanchanpur Forest Division, the villagers were explained about the benefits of cultivating broom grass along with perennial Arhar (a N2 fixing green manure plant) as an intercrop (JVDK Kumar Rao & PJ Dart, 1987). Jhumias in the village are now developing interest to cultivate this cash crop under agroforestry as an alternate to shifting cultivation. Jhuming at present is not dependable as they have realized it as a practice of negligible return. A recent participatory appraisal in the locality also revealed the economics of jhum practice unviable as a whole.

Site Profile:

The Eastern Himalayan Agro-Climatic Region covers all the northeastern states, whereas the Demo Plot of the reference Agroforestry model is in North Tripura which falls under one of the Sub Tropical Hill Zones of the Region. It receives 2,052 mm of rains and the climate is par humid to humid. In the village Depachhera, a marginal area of land is cultivable and most of the land is classified under forests.

Climatic Zone Profile:

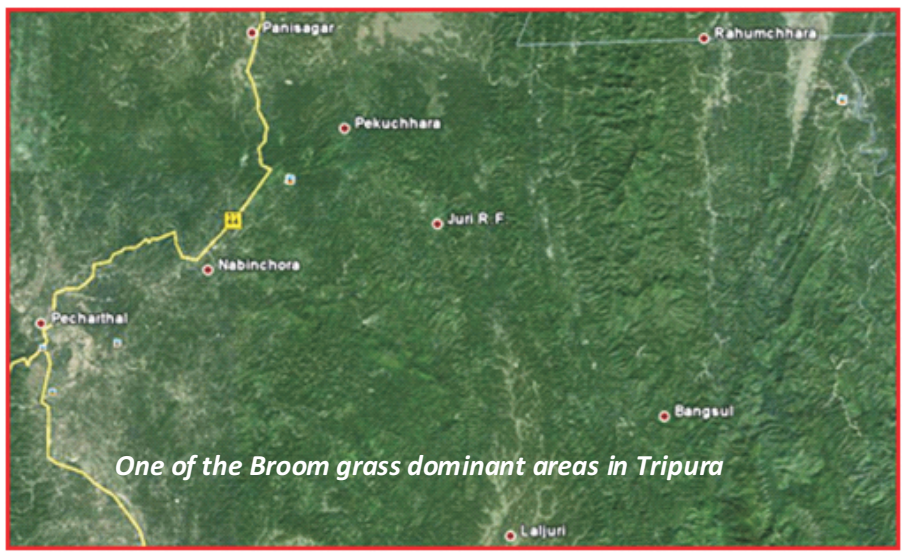
The amount of total annual rainfall varies between 1500 mm to 2500 mm with an average of 2100.7 mm which generally increases from the South-west to North-east in Tripura. The state receives rains for 99 days in a year on an average. The monsoon period is usually lasting for about 5 months from May to September as the longest season in the region. The maximum and minimum temperatures during winter are 27°C and 13°C and during summer are 35°C and 24°C, respectively (GoI, MoA - web).

The climate of Tripura is influenced by its location in the north eastern part of India and which displays characteristics that are typical of the hilly and mountainous region. The change in the topographical features of the region also causes a change in the climatic conditions in Tripura. The soil is brownish, thick layered and less fertile.

In Depachhera, shifting cultivation (Jhum) is practised in nearly 1/3 area besides 2/3 of settled cultivation and food crops are raised mainly for sustenance. Bamboo, Rice, potato, maize, banana and fruits (orange, pine-apple, lemon, litchi etc.) are the main crops.

a). Soil -

Soils are broadly classified into two categories (a) high land soils (b) low land soils. High land soils are the medium structured, fairly deep and have good internal drainage in slopes, whereas the low land soils of usually flat lands are grouped as alluvial soils



One of the Broom grass dominant areas in Tripura

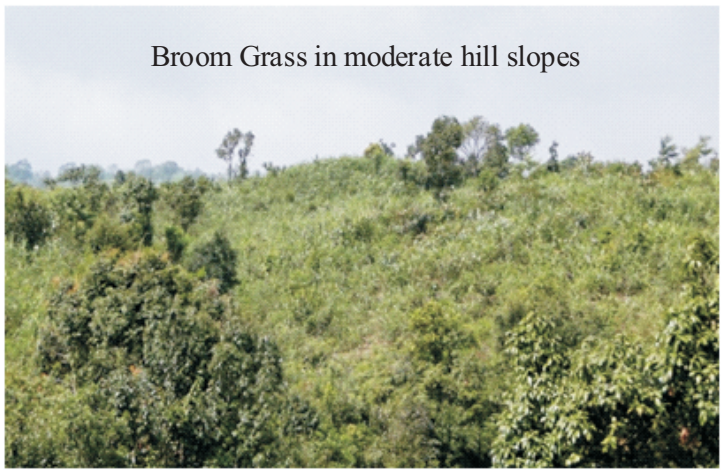
b). Topography -

Physiographically, the agro-climatic region is divisible into 3 distinct zones namely (i) Hill ranges (ii) Undulating high lands of narrow and broken plateau and (iii) Low lands and river flats.

The terrain by and large consists of parallel hills and ridges running from the northwest to the southeast direction, with alternating narrow valleys. The elevation of hills gradually increases in the east. The eastern range of the Jampui is situated at an elevation of 914 meters above MSL and the western range of the Baramura, Deotamura with its elevation of 244 meters above MSL is the lowest.

c). Socioeconomic Profile -

Apart from the jhum the villagers are mainly dependent on NTFPs like broom grass, bamboos for agarbatti sticks and edible shoots and sugandhmantri which they collect from wild. Broom grass contributes the most to their annual income whereas the local jhum practice does not have potential to depend upon. An appraisal during SWOT analysis revealed the jhum practice as highly unproductive where they could harvest only 3 kg paddy from 1 kg seeds by investing labor and care for at least 4


Broom Grass in moderate hill slopes

to 5 months. However, application of chemical fertilizers increases the productivity of their jhum by three times.

Collection and sale of broom grass from wild had been comparatively a profitable practice where they only need to invest labor and time as no initial investment is involved. Presently, due to unsustainable harvest and lack of management of natural stock, production of broom grass has been reduced to 59%

within three years during 2010 to 2013 (NCE Internal Report, 2013).

The Model:

Type of Agroforestry Model:

Broom Grass based agri-olericultural agroforestry Model

Species selected for the model (with silvicultural and cultivation details)

Upper storey –
Wild Crop: *Thysanolaena maxima* (Broom Grass)
Agriculture Crop: *Cajanus cajan* (Perennial Pigeon Pea - Arhar)

Under Storey:
Agriculture Crops: Brinjal & Chilli

Yield of broom mainly depends on the quality of planting materials and hence raising plantation with selected individuals having desired characteristics can boost the productivity of crops and ultimately uplift rural livelihood. In degraded forests and wastelands, where the root stocks are available, broom grass colonizes naturally within short period, whereas in fallows of shifting cultivation and cultivated lands, natural regeneration does not occur and broom grass is thus planted. The rhizome of broom grass from wild habitat is collected and cultivated in the cleared fields. To ensure higher economic returns, selection of desirable and superior individuals is utmost necessary. The criteria for selection of superior individuals are height of tussock, inflorescence length and number of Culm/tussock.

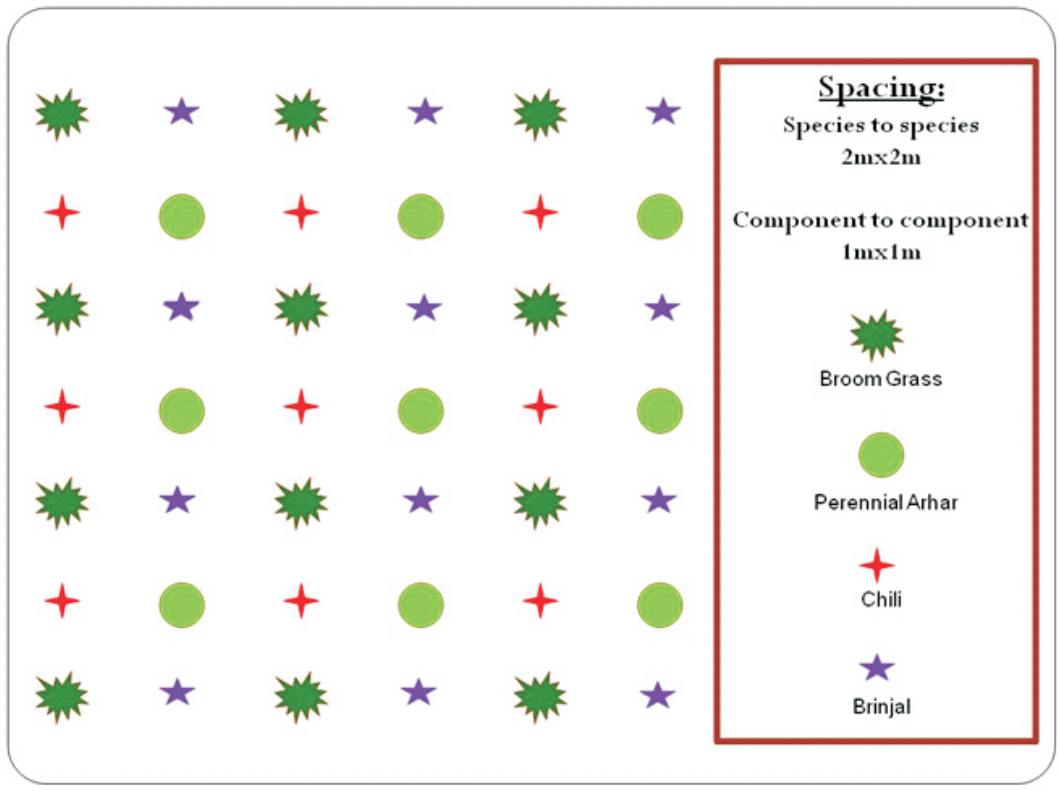
The slips collected with rhizomes were proliferated and planted in a raised bed or poly bags for multiplication. After one and half months depending upon emergence of new tillers, it was repeated for further multiplication. Weeding operation and watering were done as and when necessary. Broom grass is usually planted during April and May, and peak vegetative growth takes place during June and July. The productive period starts with the flowering of the plant in the months of October to March. The inflorescence becomes ready for harvest by December and January and the harvest continues until March. The maximum height of a tussock is attained in three years, while basal girth and culms numbers continue to increase. The culms arise centrifugally during the peak growth period and bear inflorescence at the end of vegetative growth. The increase in number of broomstick production is directly associated with the number of flowering culms. The broom yield is observed high in 2nd year cultivation due to increment of productive culms per tussock. The yield obtained from selected individuals exhibited comparatively higher value.

The other crops i.e. Arhar, Brinjal and Chilli were raised through seeds by dibbing method and maintained by applying simple intercultural operations like weeding, soil working, compost application etc.

Description of the model:

The model aims to produce broom grass as a primary product along with by-products as fodder besides generating an additional income by intercropping perennial Arhar (*Cajanus cajan*), Brinjal (*Solanum torvarum*) and Chilli (*Capsicum anum*). The slips of grass collected from wild were planted in 2m x 2m spacing. Perennial Arhar was intermixed by sowing seeds following the same spacing with broom grass plantation. Cultivation of broom grass along with perennial Arhar can significantly increase nutrient status of soil and ultimately leads to higher production. Observations from the field trials reveal about significant increase of organic carbon, total nitrogen, available phosphorus and exchangeable potassium content in the plots where broom grass were grown with perennial Arhar. (Borahip, 2012) Profuse growth of leafy foliage of perennial Arhar and its easy decomposition plays significant role for enhancement of carbon content in soil. Increment of total nitrogen is due to the contribution from root nodule and addition of biomass into the soil.

With regard to utilizing the interspaces available during initial years, the vegetable seeds like *Brinjal* and *Chilli* were also sown at 2m x 2m as under storey crop along with the two major components.


Spacing:
Species to species
2mx2m
Component to component
1mx1m
Broom Grass
Perennial Arhar
Chili
Brinjal

Market:

Prior to intervention from the local government, the villagers were engaged to deal with the market to sale broom grass collected from forests. In the year 2010, realizing the significant market potential available for the product, the government took initiative to reorganize its marketing to help improve the livelihood dependence. The JFMCs (Joint Forest Management Committees) were authorised to collect and sale broom grass. At the same time, a platform for the buyers and sellers was also provided so as to develop assured and better market linkages.

The panicle known as Arjun flower collected for making a broom is a primary product and has an organized market linkage in Tripura as well as in other neighboring states in the region. The dry Arjun flowers are sold as raw material to local and national entrepreneurs on wholesale basis. Brooms are also made out of these flowers and sold in retails to the local users. The secondary products like pulse and vegetables also have access to local markets besides meeting their requirement for domestic consumption when harvested during March to July every year.

Economics:

Input/Output Analysis for 15 years

Economics of the model is calculated on the basis of assumptions made out from the Demo Plot established at Depachhera through participatory appraisal with the practicing farmers. Their vast experience from wild collections and sale helped a lot in Input/Output Analysis, as given below

Assumptions/Basic information

Component I - Upper storey **A. Broom Grass** **B. Arhar**	**Component II - Under storey** **A. Brinjal** **B. Chilli**		
A. Broom Grass, (Average ht 10 ft) ***Thysanolaena maxima***(Phul Jhadu/Arjun)	A. **Brinjal -** No. of plants/ha - 2500 (2mx2m)		
Total No. of plants - 2500 at (2m x 2m) Area under grass - 1 ha No. of plants / ha - 2500 **Annual yield (Dry flowers in kg)**	**Expenditure/ha/yr**	Rs. 28,200/- in first yr & Rs 7000/- in subsequent yrs.	Includes cost of seeds, sowing, harvesting, and Shared expenditures on fencing, cleaning, watering and intercultural operations.

Year	kg/ per ha	Yield (kg per plant)			
			Yield / ha / yr	37.5 qt	@ 1.5 kg per plant during Jan to July every year(lean period for Broom grass)
			Sale / ha / yr	Rs. 56,250/-	@ Rs 15/- per kg (on-site, wholesale basis)
1st year	3250	1.3			
2nd year	6500	2.6	A. **Chilli - No. of plants/ha** - 2500 (2mx2m)		
3rd year	8000	3.2	**Expenditure/ha/yr**	Rs. 8000/- in first yr & Rs 7000/- in subsequent yrs.	Includes cost of seeds, cleaning sowing, watering, intercultural operations and harvesting
4th year	10000	4.0	**Yield / ha / yr**	12.5 qt	@ 0.5 kg per plant during Jan to July every year (lean period for Broom grass)
5th year	11250	4.5	**Sale / ha / yr**	Rs. 37,500/-	@ Rs 30/- per kg (on-site, wholesale basis)
……	…… …..	…… ..			
15th year	11250	4.5			

Expenditure –

Wages per manday – Rs. 200/-

Items of expenditure -

a. Annual rent of land
b. Collection of planting materials from wild – 2500 slips
c. Planting 2500 slips in 20cmx20cmx20cm pits
d. Harvesting, drying and bundling for sale

Expenditure shared with other crop components –

e. Fencing
f. Cleaning of site (sloppy with bushes)
g. Intercultural operations, casualty replacement

Sale details -

Arjun Flowers @ Rs 41/- per kg (On-site, wholesale basis)

Total sale – Rs. 65,70,250/- within 15 years. Well organized market linkages exist.

NPV @ 10% - Investment – Rs. 2.91 lakhs

- Return – Rs. 31.83 lakhs

Broom grass in 1 ha Model –

- Net Present Worth – Rs. **29.31 lakhs**

B / C ratio (@NPV) - 10.47

IRR (@NPV) - 795%

Marketing Broom Grass

A. Perennial Arhar, (Average ht 10-12 ft.)
***Cajanus cajan*(Pigeon pea)**

Total No. of plants - 2500 at (2m x 2m)
Area under Arhar - 1 ha
No. of plants / ha - 2500
Annual yield (pulse in kg)

- Pigeon peas are an important legume crop of rain fed agriculture in the semiarid tropics.
- Being very drought resistant, can be grown in areas with less than 650 mm annual rainfall.
- Contains high levels of protein and the important aminoacids methionine, lysine, and tryptophan
- Pigeon peas are both a food crop (dried peas, flour, or green vegetable peas) and a forage/cover crop.
- Being perennial, it yields at least for 3 years

Year	kg/ per ha	kg per plant
1st year	1750	0.7
2nd year	2500	1.0
3rd year	2000	0.8

Crop Rotation – 3 years	Management
1st rotation to 5th rotation	Sowing of seeds in March, harvested after 11 months.
	Plants maintained, harvested annually
	Removal of plants after annual harvest and debris used as domestic fuel for cooking.

Expenditure –

Wages per manday – Rs. 200/-

Item of Expenditures –

a. Cost of seeds (Rs. 600/-)
b. Sowing 2500 seeds in 10cmx10cmx10cm pits
c. Harvesting, drying, threshing and packaging for sale.

Expenditures Shared with other components –

d. Fencing
e. Cleaning of site (sloppy with bushes)
f. Intercultural operations, casualty replacement

Sale details -
Pulse @ Rs 30/- per kg (On-site, Wholesale basis)
Total sale – Rs. 9.99 lakhs within 15 years (Rs. 1.88 lakhs per rotation of three yrs). All season demand in local market exists.

NPV @ 10% -
Investment – Rs. 1.84 lakhs
Return – Rs. 6.61 lakhs

Arhar in 1 ha Model –
Net Present Worth – Rs. **5.10 lakhs**
B / C ratio (@NPV) - 2.77
IRR - 200%

Perennial Arhar intercropped with Broom Grass

Over all financial indicators of the MODEL for a period of 15 years.

NPV @ 10%	**-**	**Investment**	–	**Rs. 6.22 lakhs**
	-	**Return**	–	**Rs. 43.77 lakhs**
Net Present Worth of the Model			–	**Rs. 38.67 lakhs**
	B / C ratio (@NPV)		**-**	**6.21**
	IRR		**-**	**307%**

NB: Broom grass and Arhar may be grown together well as because of the low root and canopy competition due to steep to moderate slopes. The farmers have a perception that the model can yield constantly till 15 years at least.

Investment includes rent of the land (opportunity cost of Rs. 10,000/- per annum) and cost of fencing materials available in the local market.

STRATEGY FOR EXTENSION:

Extension of the model has got a vast scope in the locality. It is worth to mention here that the broom grass is being successfully introduced under cultivation. Even the neighbouring farmers in the village were unaware about the model and its potential in regard to instant and intensive income generation.

With an aim to popularize the model and extend it to other farmers' fields, an on-site meeting was organised where a total of 25 farmers participated. Though the plot exists inside the village, down a hill slope, the farmers were visiting the plot for the first instance. While taking part in participatory appraisal for economic evaluation of input and output, they were anxious to know about the net income in money terms. Realizing the benefits, they were highly motivated to take up the model on their own lands. And thus, a list of all the farmers was prepared along with their available land details for extension of model in next season. The leading farmer has also promised to help them by providing Arhar seeds and Broom grass slips at nominal cost.

CONCLUSION:

The model has been observed to be very much suitable to climatic conditions of northern Tripura and thus, could also be extended to other Sub Tropical Hill regions of NE India. Almost every crop-component of this model is suitable to be grown with broom grass under agroforestry on wastelands/degraded lands ranging from steep to moderate hill slopes in the region. Besides broom grass, the crops produced in different seasons also have instant demand in market. Moreover, broom grass as main crop has an organized market in the region and fetches a subsistence income to the growers annually even up to 12 to 15 years. The model may be renewed gradually and productivity can be maintained by selective replacement of old and unproductive clumps by planting new grass slips as and when required. Thus, the model could be practised as a much viable and sustainable practice in the region.

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