TRENDS OF LIVELIHOOD DYNAMICS FORM AQUATIC TO TERRESTRIAL: A STUDY OF FISHING COMMUNITY IN INDIAN THE SUNDARBANS

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Abstract

Fishing in the Sundarbans is quite risky and threatening due to chance of sudden attack of fierce animals and seasonal occurrence of cyclones at the Bay of Bengal. Fishing yield also is uncertain and inconsistent, especially over the last two decades burgeoning population growth exerts a continuous pressure on the fishing resources. Moreover, increasing school attainment among younger generation declines the rate of their early engagement in ancestral occupation. Such scenarios of livelihood contexts and livelihood assets pose serious threats to the livelihood system. To combat with this situation people of the Sundarbans adopt different livelihood strategies and eventually they leave aquatic occupations and adopt terrestrial one. Since the last two decades such change of livelihood pattern has been profoundly observed. To explore these changing scenarios, the present article has been made an attempt to unfold the relationship among livelihood assets, livelihood contexts and livelihood dynamics for the fishing community of the Indian Sundarbans.

Key Words: Livelihood dynamics, livelihood asset, livelihood context, Seasonality, shock, trend.

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1.0 Introduction

Nature of man-resource relationship has been modified with the course of time. This results the adoption and adaptation of livelihood strategies over the time period (Ellis, 1998). Livelihood strategies are responsive to the changing pressure on resource base and to the new opportunities, and adapt accordingly (Ellis, 2000). This leads to a momentum in livelihood dynamics which is pivot theme of the present article. Fishing villages along Matla river have undergone a major transformation in terms of man-resource relationship over the last three decades, which significantly have changed mobility of livelihood from aquatic to terrestrial. This mobility depends on the socio-economic and environmental context of which the households are important part (Bryceson, 2000). Thus present article is devoted to unfold the nature of livelihood dynamics of fishing occupation and at the same time it tries to relate it with socio-economic and environmental context of livelihoods.

It is evident from the earlier research works that people feel more attachment with such a livelihood relating to natural environment and dealing with common property resources (Thomsen et al., 2001). However, some researchers consider environmental risk to be the fundamental motive for livelihood alteration (Bryceson, 2000), especially for the livelihoods relating to natural set up. In the Sundarbans fishing is mostly uncertain and threatening in terms of natural calamities and biotic hazards (Sarkar, 2009). It is associated with high degree of exposure to risk, shocks and stress as well as proneness to uncertainty. Thus, there is a question of livelihood vulnerability. On the other hand, different socio-economic variables like – population pressure, seasonality of yields, market prices, educational increase all together bring difficulties for the smooth running of livelihoods and eventually increases its vulnerability (Ellis, 1998).

2.0 Theoretical Consideration

The present paper has settled in the context of livelihood dynamics. According to Chambers and Conroy, '…livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base' (Ellis, 2000).

The essential feature of **livelihood system** is related to some important terms. These are – **livelihood assets**, **livelihood context**, **livelihood strategy**, and **livelihood vulnerability**.

In livelihood analysis **assets** are treated as a basis of survival. This is the most important aspect which may be tangible or not. Economists have identified five types of assets on which households sustain in terms of material well-being (Ellis, 2000). These are natural capital, physical capital, financial capital, human capital and social capital.

The set of assets are translated into a livelihood strategy in the milieu of social, economic, political, and environmental context. These are referred to as **livelihood context** which affects on the ability to access and use of assets for a favourable outcome. The Economists detected two basic form of livelihood context (Ellis, 2000). First one is the **endogenous context** which comprises **social relations**, **socio-political organisation**, **social norms** and **values**. These aspects are deeply embedded in the structure of society and undergone with very little change over time. The second context includes **trend**, **seasonality** and **shock** factors which are **exogenous** in their actions. These basically influence on the ability to access the assets, whereas endogenous context modifies livelihood strategies to some extent. The **trend** factor in exogenous context indicates population growth, migration, technological change, relative prices, and macro policy. The **seasonality** factor includes increasing and decreasing rate of availability of resources, income generating opportunities, demand of products. The **shock** factor represents a particular challenge to livelihood sustainability in the form of flood, drought, cyclones, wars etc.

The asset status of households, mediated by endogenous and exogenous context are translated into adoption and adaptation of **livelihood strategies**. The strength of livelihood is not only measured by its productive outcomes, but equally by its resilience and less sensitive to shocks, seasonal change, and trends (Ellis, 2003). A livelihood is said more **vulnerable** if it is unable to readjust due to change in assets or activities. A secure livelihood is closely connected to substitution capabilities among assets and activities (Ellis, 2003).

Now investigation adopts a framework (Ellis, 2000) for the clear understanding of livelihood dynamics (Fig.1). This is a version of the 'assets-mediating process-activities' that is adopted by different researchers. In the column 'A' platforms of livelihood are assigned in the name of livelihood assets. This set of assets represented in the column 'B' is mediated through

two different forms of livelihood contexts – endogenous and exogenous. This mediation turns into livelihood strategies with adoption, adaptation, substitution and coping mechanism. This process is exhibited in the column 'C'. Later on endogenous and exogenous contexts stimulate the livelihood sustainability and disturb the equilibrium. This coined as livelihood vulnerability is represented in column 'D'. With the course time of time, livelihood adjusts or readjusts with its underlying context and seeks new strategy for survival (column 'E').

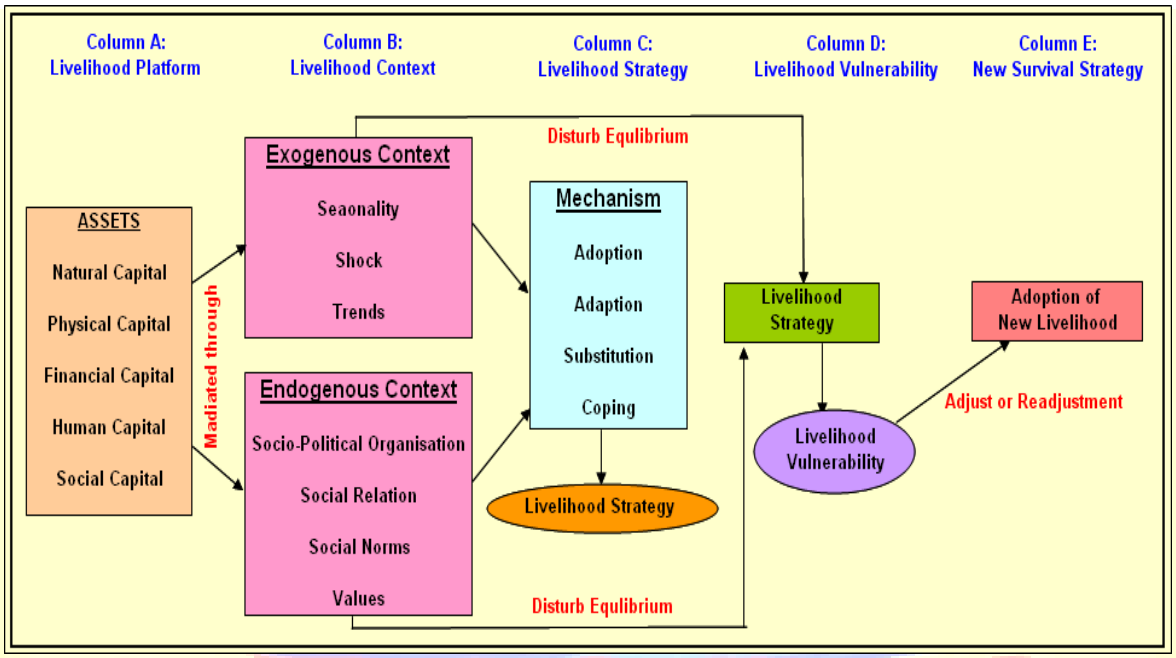

Fig. 1 **(Structure of Livelihood Dynamics)**

3.0 Rationale to the Problem

Over the last two decades (since 1990s) burgeoning population growth exerts a continuous pressure on the available resource in the Sundarbans (Danda, 2007). This increased population growth diminishes abundant fishing resources (trend) due to indiscriminate fishing (Kanjilal, 2000). In addition to this, fishing in deep river is quite risky and threatening due to chance of sudden attack of fierce animals and seasonal occurrence of cyclone at the Bay of Bengal (shock). Moreover, fishing yield is mostly uncertain and inconsistent (Seasonality). To combat with this situation people adopt different livelihood strategies like adoption of new techniques, livelihood diversification, and eventually migration. Today, mostly younger age group prefer to migrate in the urban areas for their survival means and decide to settle there permanently (trend). This phenomenon is evident for the fishing community of the Sundarbans

(Sarkar, 2009). The changing scenario coupled with increasing formal education leads to change livelihoods throughout the whole Sundarbans, especially in the form of rural to urban occupations (Pramanik, 2008). The exogenous context of livelihood in the forms of shocks, seasonality and trends continuously undermines occupational attachment of fishing community.

Fishing in the Sundarbans is performed through collaborative performance that leads intense social interaction among the fishermen and their family members. On the other hand, uncertainty and fear-psychosis of this occupation ties people to be involved and accustomed with the myth of rituals, customs and devotion to their localised deities (Ghoshal, 2006). Thus social bond and value system form strong base of endogenous items for fishing livelihood. Apart from this, natural resource projects a positive impression in the cognitive environment of man. The aesthetic component of the riverine resource ties people in their social-economic life and carry on livelihood pattern within a smooth track. In a natural set up, man likes to behave as an ecological man instead of an economic man. Moreover people enjoy equal right to access the common property resources. This phenomenon plays a significant role in the characterisation of endogenous items of fishing livelihood and subsequently influences on the livelihood strategy of man. With this mindset (Fig. 2), the present article aims to unfold the relationship among livelihood assets, livelihood context and livelihood strategies.

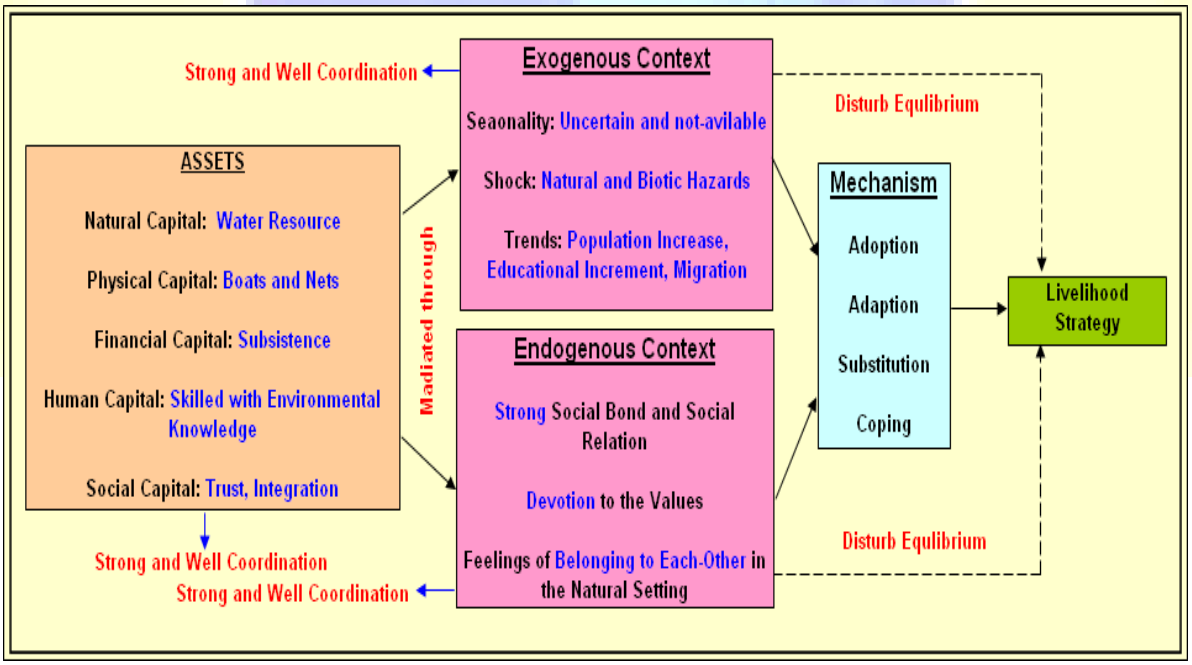

Fig. 2 **(Structure of Fishing Livelihood)**

4.0 Area under Study

The present study is undertaken in the three villages situated along the left course of Matla river in the Sundarbans. These are – Bhangankhali, Purandar and Jhorkhali-4 (Fig. 3). The reason behind such selection is multifaceted. **First**, these three villages are predominantly caste-oriented (out of total eleven caste villages along the Matla river). Since time immemorial, the fishermen of these villages are involved in fishing pursuits from one generation to another and still persist appreciably. **Second**, the selected villages are located from each other with substantial distance along the river side (from North to South). This situation facilitates to be considered a variety of conditions from the north to the south. Riverine condition is deteriorated in the northern part but the condition is more energetic in the south. **Third**, there are significant differences exist among these fishing villages in terms of their livelihood assets and exogenous items. It is axiomatic true that livelihood dynamics depend on livelihood assets and exogenous items (Fig. 2). In the present inquiry, the differential samples may help to understand the relationship among different variables of livelihood system. The following noticeable differences of livelihood assets and exogenous items can be pointed out during pilot investigation.

Livelihood Asset

Natural Capital: Along the riverside villages fishes are mostly abundant at the southern end due to presence of deep estuarine ecosystem. At the South, human interference is relatively less and also biodiversity is quite high, which subsequently keep fishing resources at an adequate amount over time. Thus, the southern villages have easy access to this resource in comparison to the northern ones. However, fishing resource is abundant at South but access to it is highly risky and threatening.

Physical Capital: Due to the stronger fishing environment towards the South, fishing gears are more equipped and more in numbers for the southern villages in comparison to the northern one (Table 1).

Human Capital: 1. Pilot survey reveals that fishermen of the southern villages are more experienced about risk and hazards which are seemingly low at the North (Table 1).

2. In respect to environmental knowledge (Table 1), fishermen of the southern villages are more advanced than that of northern fishermen. Thus, regarding all sorts of fishing pursuit, southern villages are highly skilled.

Exogenous Items

Shocks: Unwanted situations like – striking of cyclones and biotic hazards are very effective at the South in comparison to the North. Thus, fishermen of the southern villages are more confronted with the problems of uncertainty by natural calamities (Table 1).

Seasonality: Due to abundant resource at the south, uncertainty of yields are seemingly low in respect to the northern villages (Table 1).

Trend: 1. Educational status of each village is an important determinant of livelihood dynamics. It has been found from the pilot survey (Table 1) through the in-depth interview that after achieving substantial formal education, younger generation switches off their family occupation and migrates or shifts in the urban areas for the means of survival. Such a change has been noticed significantly in Purandar for the last ten to fifteen years. Increasing formal education leads to change of motive and attitude of younger generation and it might undermine ancestral occupational attachment. This trend has also been observed in Jhorkhali-4, however no substantial change of level of education level has been found in Bhangankhali (Table 1).

2. Fishing is quite risky and threatening as well as marked by uncertainty and unpredictability. But it was difficult to leave it as fishing families keep on their ancestral livelihoods since time immemorial. Moreover, due to their poverty stricken conditions, it is not easy for them to take the risk of other types of occupations. Fishing villages with better financial position are gradually avoiding their ancestral livelihoods because of risk and chance factors. This trend is found little bit in some fishing caste villages throughout the whole Sundarbans (Sarkar, 2009). With this mindset, villages with different financial status have been taken into consideration. Among the three, Purandar is one of the advanced villages with better financial support followed by Jhorkhali-4. Financial base for Purandar is comparatively better but per-capita earnings from fishing are quite higher for Jhorkhali-4 due to its southern location. However, the fishermen of Bhangankhali belong to the poorest of the poor (Table 1).

Table 1: Result of Pilot Survey Relating to Status of Livelihood Assets and Exogenous Context of the Three Selected Fishing Villages

Villages	Samples		Physical Capital		Human Capital			Shock	Seasonality		Trends	
	Household	Individual	Boats /Household	Nets/ Household	Number of Cyclones Experienced by Individual/10 years	Tiger Attacks' Experienced by Individual/10 years	Fishing Knowledge by Individual*	Adoptability of Shock by Individual	Household Income in Lean Season (%)	Fishing in Lean Season (%)	Average Education /household	Monthly Per-Capita Income
Bhangankhali	20	43	1.50	2.00	2 - 3	2	4.50	2.0	20.25	15	Class III	Rs. 370
Purandar	20	46	2.25	2.85	3 - 7	9	7.25	6.0	30.00	35	Class X	Rs. 895
Jhorkhali-4	20	48	2.75	3.25	4 -11	14	8.50	7.5	36.50	33	Class VIII	Rs. 755

*Fishing knowledge has been calculated by taking a set of ten questions in the pilot survey and their average result has been displayed.

The following tables represent (Table 2) the sample statistics and characteristics of the selected villages.

Table 2: Characteristics of the Selected Riverine Villages

Criterion	Village's Name			Bhangankhali	Purandar	Jhorkhali-4
	Sample Families			60	90	64
Riverine Case	Livelihood Assets			Feeble → Strong		
	Exogenous Context	Shock		Feeble → Extreme		
		Seasonality		More → Less		
		Trends	Educational Increment	Low	High	Moderate
			Financial Status	Low	High	Moderate

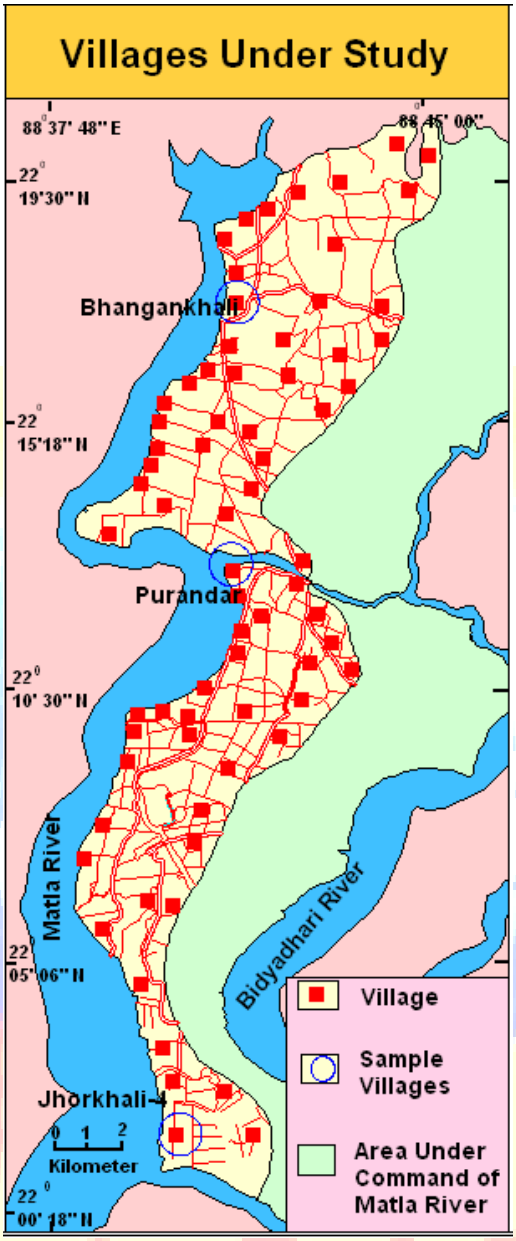

Fig. 3

1.5 Materials and Methods

Samples were taken from the three aforesaid villages considering complete family unit (include one or more than one households) with three successive generations. Such a sample facilitates to allow generation-wise change of family occupation over time. The size of the sample is varied from 89 to 60, depending on the size of the families. Information has been gathered from the selected families in different aspects. These are – individual occupation (in 1990s and 2011-12), individual education, age and place of out-migration.

The collected data has been used to quantify livelihood status in two time points respectively – 1990s and 2011-12. The 1990s represent previous situation as most of the changes occurred after that period. On the other hand, 2011-12 signifies livelihood of present situation.

1.6 Analysis

Along the river side, fishing serves as the prime source of engagement and occupation for most of households. The field investigation grounds that most of the villages along the Matla river sustain their livelihoods in the aquatic occupations. However, from the last two decades a trend of occupational change has been detected from aquatic to terrestrial (Sarkar, 2009). It is axiomatic true that the southern villages enjoy better opportunity of fishing as they have good access to resources, adequate physical capital, and higher risk taking ability with adequate fishing knowledge. Though they are more exposed to risk but feebly affected by seasonality. With this conjecture, it can be assumed that fishermen of Jhorkhali-4 would show more consistency in their ancestral occupation, whereas the scenario of Bhangankhali would be vice-versa.

Empirical Findings

Aquatic livelihoods comprise of different types of occupations. Here, five types of occupation have been recognised – fishing business (FB), fishing net making (FN), tiger prawn seed collection (SC), river fishing by country boats (FR) and estuarine fishing by trawler (FE). On the other hand, three types of terrestrial occupation have been considered to address inter-occupational mobility. These are – agriculture (AG), labour work (LB) and migration strategy (MG).

To highlight inter-occupational mobility the database is articulated in the form of matrix (Table 3A, 3B, 3C) by which trend of mobility can be perceived easily. It is clear from the matrix that among the three villages only Jhorkhali-4 exhibits a higher loading in terrestrial occupation in 1990s. It amounts to 27.24%, wherein Bhangankhali and Purandar records only 9.64% and 6.74% respectively (articulated in the Table 4). Response of Jhorkhali-4 is really unexpected according to the proposition stated earlier. The statistic clearly voices that mobility to the terrestrial occupation is not the recent phenomena in Jhorkhali-4. It was actually embarked on the days of its origin. Further to note that among all the villages along the Matla river,

Jhorkhali-4 is the youngest one. Establishment of this settlement dates back to 1950s by the influx of refugee population from present Bangladesh. Originally, this refugee population belonged to fishing caste; though some agricultural lands were given to them for their immediate survival. In the beginning they settled in aquatic occupations and somehow they managed their needs for survival. Fishing was not a commercial function at that phase as it is observed today. The earning from it was not enough to fulfil the family needs, especially at the beginning of settlement development. They require more financial support for their family welfare. To meet the needs one or two members of each family were gradually shifted to non-aquatic sectors. This trend is the notion of breaking of ancestral legacy. In contrary to this, two other villages have a history of more than hundred years. In those days, living costs were marginal and people were socio-culturally apathetic to their ancestral livelihoods. Hence only aquatic occupations could meet their survival needs. This results to the adaptation in their cultural habit.

Table 3A: Livelihood Dynamics: Intra & Inter Occupational Mobility - Bhangankhali

Present			2011-12								Total in 1990s
Past	Occupation		Aquatic					Terrestrial			
			FE	FR	SC	FN	FB	AG	LB	MG	
1990s	Aquatic	FE	0	0	0	0	0	0	0	0	0
		FR	0	139	4	0	2	**4**	**22**	**1**	172
		SC	0	0	2	0	0	0	**2**	0	4
		FN	0	0	0	0	0	0	0	0	2
		FB	0	0	0	0	2	0	0	0	0
	Terrestrial	AG	0	1	0	0	0	0	0	0	1
		LB	0	3	0	0	0	0	11	3	17
		MG	0	0	0	0	0	0	0	1	1
Total in 2011-12			0	143	6	0	4	4	35	5	197

Table 3B: Livelihood Dynamics: Intra & Inter Occupational Mobility – Purandar

Present			2011-12								Total in 1990s
Past	Occupation		Aquatic					Terrestrial			
			FE	FR	SC	FN	FB	AG	LB	MG	
1990s	Aquatic	FE	24	1	0	0	1	0	**2**	**4**	32
		FR	21	46	1	3	8	**3**	**16**	**14**	112
		SC	4	11	15	2	3	2	**44**	**33**	114
		FN	0	0	0	0	0	0	0	0	5
		FB	0	0	0	0	5	0	0	0	0
	Terrestrial	AG	0	0	0	0	0	0	0	0	0
		LB	0	0	0	0	0	0	15	2	17
		MG	0	0	0	0	0	0	0	2	2
Total in 2011-12			49	58	16	5	17	5	77	55	282

Table 3C: Livelihood Dynamics: Intra & Inter Occupational Mobility – Jhorkhali-4

Present			2011-12								Total in 1990s
Past	Occupation		Aquatic					Terrestrial			
			FE	FR	SC	FN	FB	AG	LB	MG	
1990s	Aquatic	FE	61	0	0	0	0	0	**3**	**2**	66
		FR	4	104	1	1	1	**2**	**6**	**21**	140
		SC	1	0	2	0	0	0	**0**	0	3
		FN	0	0	0	0	2	0	0	0	0
		FB	0	0	0	0	0	0	0	0	2
	Terrestrial	AG	0	0	0	0	0	4	0	0	4
		LB	0	0	0	0	0	0	33	5	38
		MG	0	0	0	0	0	0	0	37	37
Total in 2011-12			65	105	3	1	3	6	42	65	290

Note: The bold letters indicate occupational mobility from aquatic to terrestrial.

Table 4: Engagement in Terrestrial Occupation

Village's Name	Accepted Number of Heads	In absolute number		In %	
		1990s	2011-12	1990s	2011-12
Bhangankhali	197	19	44	9.64	22.34
Purandar	282	19	137	6.74	48.58
Jhorkhali-4	290	79	113	27.24	38.97

From the matrix, the data relating to inter-occupational mobility has been tabulated in the Table 5. It clearly spells out that Purandar village shows sound response in aquatic to terrestrial mobility with the loading of 44.87%. The statistic signifies that almost 45% of fisherfolk has shifted to non-aquatic sectors over the last two decades. The corresponding figure is 16.29% and 16.11% for Bhangankhali and Jhorkhali-4 villages respectively. Thus finding exhibits a marked difference from the expectation. In the context of resource utilisation and availability of physical and human capital; the occupational shifting from aquatic to terrestrial would have been highest for Bhangankhali with a sequence of Purandar and Jhorkhali-4. But it is shocking that fisherfolk of Purandar over the last two decades have moved on to land economy. To find out the rate of transformation, occupation-wise participation data (not number of persons, but number of participation, because one man can be involved more than one occupations) has been taken into consideration. The occupation-wise participation data (percentage-wise) has been enumerated (Table 6) in two time points under the following heads:

a. Estuarine fishing and river fishing (A),

b. Tiger prawn seed collection, Fishing net making and Fishing Business (B),

c. Local labourers (C) and

d. Migration Strategy (D).

Table 5: Inter-Occupational Mobility

Village	Aquatic to Terrestrial (1990s to 2011-12)		Terrestrial to Aquatic (1990s to 2011-12)	
	Number of Heads engaged in aquatic Occupation in 1990s	Number of Heads shifted to terrestrial Occupation in 2011-12	Number of Heads engaged in terrestrial Occupation in 1990s	Number of Heads shifted to aquatic Occupation in 2011-12
Bhangankhali	178	29 **(16.29%)**	19	4 **(21.05%)**
Purandar	263	118 **(44.87%)**	19	0 **(00.00%)**
Jhorkhali-4	211	34 **(16.11%)**	79	0 **(00.00%)**

Table 6: Occupation-Wise Participation (in Percentage)

Village	Occupation →	A	B	C	D
	Grades of Occupation →	4	3	2	1
Bhangankhali	**1990s**	54.84	38.71	6.22	0.23
	2011-12	38.48	47.24	13.13	1.15
Purandar	**1990s**	44.44	52.04	3.15	0.37
	2011-12	35.91	18.12	27.52	18.46
Jhorkhali-4	**1990s**	54.33	29.28	9.58	6.81
	2011-12	44.88	25.59	13.58	15.94

Such a sequence from A to D clearly signifies a trend of occupational shift from aquatic to terrestrial. The database counts all the occupations in which a person is engaged. Thus, it represents the number of participation (in %) in the mentioned occupations in stead of number of persons. Articulated data is treated in regression analysis in the form of $y = a + bx$, wherein X-axis represents the grade of occupation starting from 1 (migration strategy) to 4 (estuarine and river fishing) and Y-axis represents occupation-wise participation. The value of b denotes occupational trend and its decrease signifies the trend of occupation mobility from aquatic to terrestrial. On the other hand negative or low intercept value stands for aquatic occupation and its increase denotes the vice-versa.

From the regression analysis three sets of equation have been derived. These are as follows:

Village	Equation	Duration
Bhangankhali:	$y = 19.631x - 24.078$ ($r^2 = 0.942$) …(1)	(Past - 1990s)
	$y = 14.608x – 11.521$ ($r^2 = 0.770$)….(2)	(Present – 2011-12)
Purandar:	$y = 18.111x – 20.278$ ($r^2 = 0.747$)…(3)	(Past - 1990s)
	$y = 4.985x + 14.262$ ($r^2 = 0.428$)….(4)	(Present – 2011-12)
Jhorkhali-4:	$y = 16.225x – 15.582$ ($r^2 = 0.909$)…(5)	(Past - 1990s)
	$y = 9.881x + 0.2953$ ($r^2 = 0.803$)….(6)	(Present – 2011-12)

From the equations it is clear that intensity of inter-occupation mobility is the highest in Purandar village with a decrease of slope value (b value) from 18.111 to only 4.9853 and with simultaneous increase of intercept value from -20.278 to +14.262. Jhorkhali-4 village stands thereafter with significant decrease of slope from 16.225 to 9.8819. At the same time intercept value alters its direction from -15.582 to +0.2953. The last one is Bhangankhali villages which records very minimum change in terms of slope and intercept parameters.

Relating to this analysis another important study has been made to find out the contemporary trend of occupation mobility among the younger generation (age 13 to 19). The data base has been articulated (Table 7) under the three following heads:

1. Desire of mobility to aquatic choices,
2. Desire to mobility to terrestrial choices and
3. Engagement in studies.

Table 7: Preference to Different Occupations and Engagement for Younger Generation

Villages	Total Samples	Preference to		
		Aquatic Occupation	Terrestrial Occupation	Education
Bhangankhali	46	25 (54.35%)	18 (39.13%)	3 (6.52%)
Purandar	40	15 (37.50%)	6 (15.00%)	19 (47.50%)
Jhorkhali-4	53	5 (9.43%)	26 (49.06%)	22 (41.51%)

The data exhibits a decreasing trend of aquatic choices from Bhangankhali to Purandar and thereafter to Jhorkhali-4. On the other hand, choice to the terrestrial occupations is prominent mostly in two villages – Bhangankhali and Jhorkhali-4. The most striking event is the increasing involvement of teenage population in their education that is prominent mainly in Purandar and

Jhorkhali-4. Fifteen to ten years ago teenage population usually participated in household occupation, especially in tiger prawn seed collection. Everyday, at that time thousands of teenagers with their parents were wading through neck-deep water against the force of the ebb currents for hours to collect prawn seeds (Kanjilal, 2009). Teenage population of school going age did not go to school and would drop out permanently. With the course of time they enduringly would settled in fishing occupation. But the scenario has altered for last five to ten years. Due to the fall of market price of tiger prawn, teenage population is now attending school due to growing awareness of school education. Nowadays, parents motivate their children to continue their education at least up to tenth standard. This change in the educational status as well as in people's attitude of Purandar and Jhorkhali-4 has simultaneously changed the direction of livelihood dynamics from aquatic part to terrestrial sphere.

At the last stage of this inquiry collected data has been organised according to age groups and thereafter percentage of population (male only) engaged in aquatic occupations (includes FE, FR, SC, FN and FB) has been calculated (Table 8). Later on polynomial regression has been employed to show the trend of age-wise participation. The calculated data presented in the Table 8 has been employed in regression analysis (Fig. 4a, 4b and 4c). Second degree polynomial equation has been used in two time points (1990s and 2011-12) due to its goodness of fit in maximum cases. The coefficient of x^2 (terminal slope) of the equations signifies the participation rate of relatively younger ages (younger generation) and reverse direction denotes its declining trend.

The figure depicts that except Bhangankhali, other two villages exhibit a sharp declining trend from 1990s to 2011-12. The coefficient of x^2 in 1990s is almost same for Bhangankhali and Purandar (-0.0080 and -0.0097), though a substantial declining trend (-0.0291) is found for Jhorkhali-4. On more than one occasions it has been pointed out that the trend of aquatic to non-aquatic occupation is an age old phenomenon in Jhorkhali-4. Due to its recent origin, substantial negative trend has been found even in 1990s. However, other two shows satisfactory response regarding participation of young generation at the same time point. In respect to present situation, Purandar (-0.0097 to -0.0923) and Jhorkhali-4 (-0.0291 to -0.0682) exhibit a sharp declining trend of participation rate from 1990s to 2011-12. The response of Bhangankhali is relatively less (-0.0080 to -0.0259) which reaffirms our earlier findings.

Table 8: Age-Wise Engagement in Aquatic Occupations

Village	Age Groups	Past (1990s)			Present (2011-12)		
		Total Population	Engaged in Aquatic Occupation	Percentage	Total Population	Engaged in Aquatic Occupation	Percentage
Bhangankhali	70-75	48	39	81.25	36	18	50.00
	65-70	14	12	85.71	8	5	62.50
	60-65	17	14	82.35	12	7	58.33
	55-60	15	13	86.67	8	6	75.00
	50-55	15	12	80.00	6	5	83.33
	45-50	14	12	85.71	11	8	72.73
	40-45	11	10	90.91	19	14	73.68
	35-40	18	15	83.33	17	14	82.35
	30-35	17	14	82.35	28	20	71.43
	25-30	28	24	85.71	22	16	72.73
	20-25	38	30	78.95	49	36	73.47
	15-20	61	47	77.05	59	38	64.41
Purandar	70-75	57	57	100.00	42	7	16.67
	65-70	37	37	100.00	30	6	20.00
	60-65	14	14	100.00	29	20	68.97
	55-60	32	31	96.88	18	14	77.78
	50-55	20	20	100.00	23	18	78.26
	45-50	23	22	95.65	27	20	74.07
	40-45	28	26	92.86	27	17	62.96
	35-40	27	27	100.00	28	9	32.14
	30-35	28	27	96.43	28	10	35.71
	25-30	29	25	86.21	51	10	19.61
	20-25	51	42	82.35	42	10	23.81
	15-20	48	39	81.25	34	6	17.65
Jhorkhali -4	70-75	49	49	100.00	40	16	40.00
	65-70	24	23	95.83	26	20	76.92
	60-65	13	13	100.00	18	17	94.44
	55-60	20	19	95.00	21	16	76.19
	50-55	21	19	90.48	21	16	76.19
	45-50	21	19	90.48	19	14	73.68
	40-45	19	17	89.47	26	20	76.92
	35-40	26	23	88.46	27	19	70.37
	30-35	28	24	85.71	48	29	60.42
	25-30	48	35	72.92	47	19	40.43
	20-25	47	24	51.06	56	17	30.36
	15-20	55	23	41.82	41	4	9.76

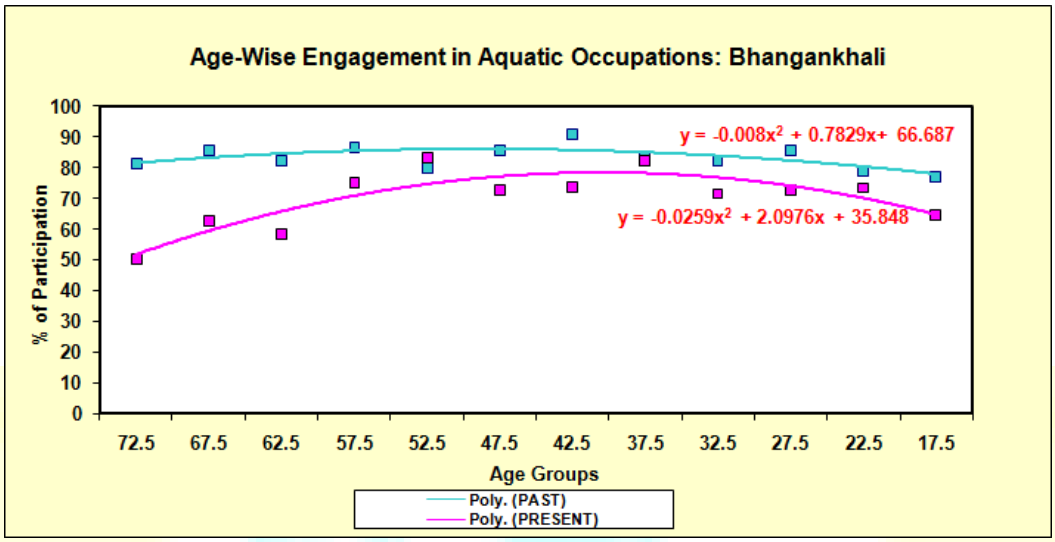
Age-Wise Engagement in Aquatic Occupations: Bhangankhali
y = -0.008x² + 0.7829x+ 66.687
y = -0.0259x² + 2.0976x + 35.848
% of Participation
Age Groups
72.5 67.5 62.5 57.5 52.5 47.5 42.5 37.5 32.5 27.5 22.5 17.5
Poly. (PAST)
Poly. (PRESENT)

Fig. 4a

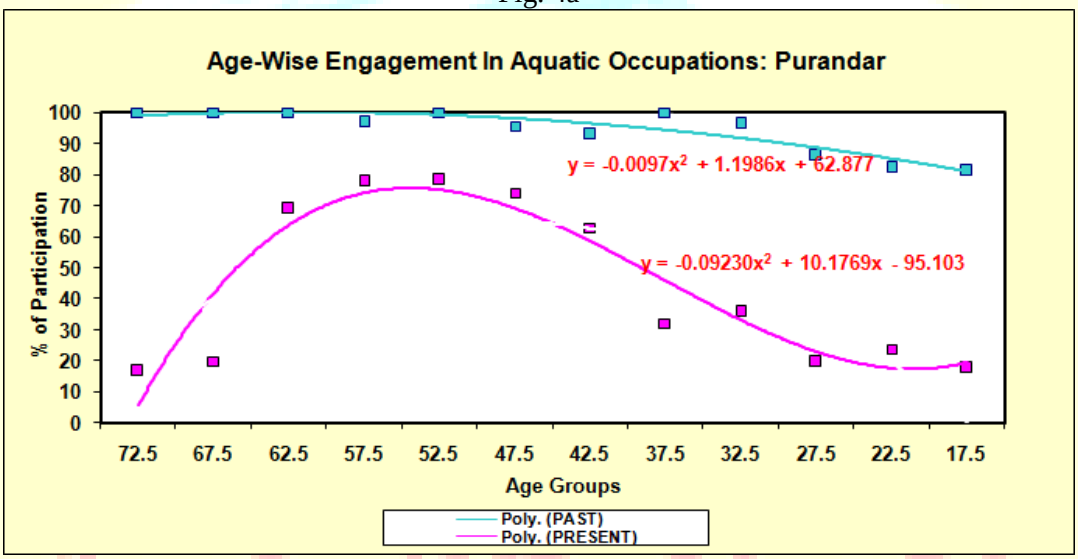
Age-Wise Engagement In Aquatic Occupations: Purandar
y = -0.0097x² + 1.1986x + 62.877
y = -0.09230x² + 10.1769x - 95.103
% of Participation
Age Groups
72.5 67.5 62.5 57.5 52.5 47.5 42.5 37.5 32.5 27.5 22.5 17.5
Poly. (PAST)
Poly. (PRESENT)

Fig. 4b

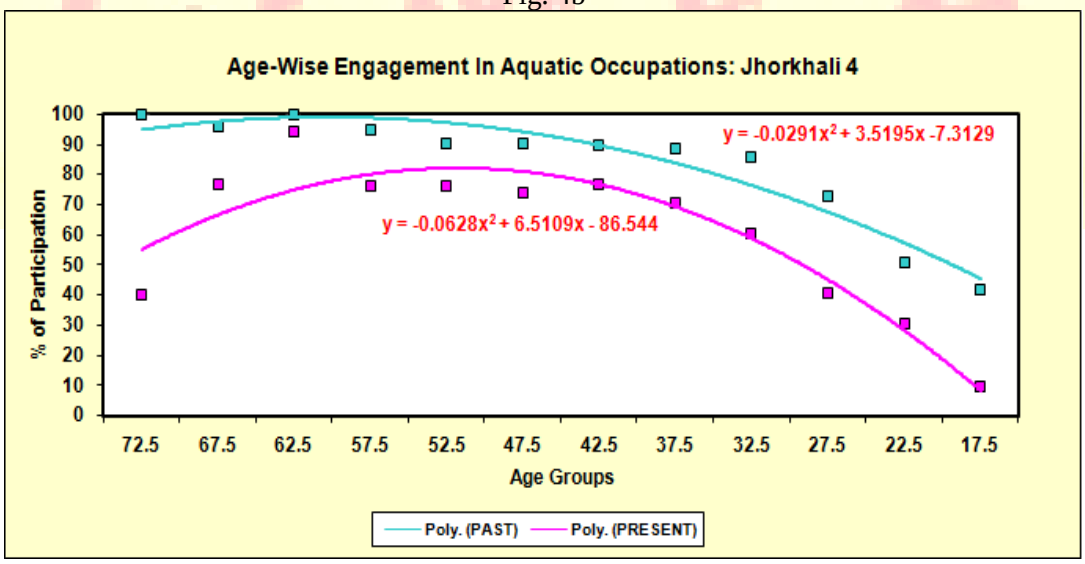
Age-Wise Engagement In Aquatic Occupations: Jhorkhali 4
y = -0.0291x² + 3.5195x -7.3129
y = -0.0628x² + 6.5109x - 86.544
% of Participation
Age Groups
72.5 67.5 62.5 57.5 52.5 47.5 42.5 37.5 32.5 27.5 22.5 17.5
Poly. (PAST)
Poly. (PRESENT)

Fig. 4c

Now, to find out the exact age bracket wherein occupational participation turns to decline, differential calculus has been logically applied for 2011-12. By putting dy/dx = 0, critical age bracket has been detected and is presented in the Table 9. A careful examination of the table reveals that critical age bracket is highest in Purandar, followed by Jhorkhali-4 and Bhangankhali in 2011-12. The result conclusively prompts that occupational mobility from the aquatic to the terrestrial is higher in Purandar, because fisherfolk at age of 55 turns to shift into non-aquatic sectors and so likely, below this age bracket other persons may have altered their livelihoods from aquatic to terrestrial. The corresponding figure of 52 for Jhorkhali-4 also grounds the same finding. In spite of these, the obtained value for Bhangankhali is only 40. This response signifies that only young generation has settled in non-aquatic occupations.

Table 9: Derived Critical Age for Aquatic Occupational Engagement

Village	Equations	r- square value	x at dy/dx = 0
Bhangankhali	$Y = -0.0259x^2 + 2.09760x + 35.848$	0.7448	40.49 (40)
Purandar	$Y = -0.0923x^2 + 10.1769x - 95.103$	0.8741	55.13 (55)
Jhorkhali-4	$Y = -0.0628x^2 + 6.51090x – 86.544$	0.8738	51.83 (52)

1.7 Discussion

Several environmental aspects come into play in modifying the activity space of the people of Sundarbans. Present discussion tries to unfold different physical and non-physical factors relating to livelihood context which are liable to change the livelihoods from aquatic to terrestrial.

Different physical attributes are assumed as significant factor for the occupational mobility. Here the discussion includes four physical attributes like – risk factor, uncertain yield, decreasing resources, resource availability etc. Beside these, socio-cultural aspects of the three villages are analysed as a backdrop of this inquiry.

It is almost clear that Purandar village is in advanced stage of livelihood dynamics, followed by Jhorkhali-4 and Bhangankhali. The leading position of Purandar is somewhat unexpected, because fishing was the prime option for family income around twenty years back. The unexpected behaviour is the manifestation of several factors. **Firstly**, aquatic occupation is

the most vulnerable occupation for its natural vagaries and uncertain yields (shocks and seasonality). Hence, the risk factor acts as a striking barrier to the fisherfolk of Purandar village due to their moderate amount of risk taking capability (human capital). **Secondly**, declining amount of fishing resource causes economic crisis seasonally (seasonality). These two environmental factors all together are responsible for declining fishing trend of Purandar village since last two decades. This trend is coupled with **third factor** that have significantly reduced the number of fisherfolk, especially among the youngest generation. This one is the most important factor relating to educational attainment of younger generation (trend). Change in education status has certainly changed the mind-set of the younger generation (trend). To reveal the role of education, regression analysis has been made to detect age-wise change of education level for the three villages. For this, y = a + bx equation has been adopted, wherein age is treated as a function education. The derived equations are as follows:

Bhangankhali: $y = -0.0360x + 3.296$…..(7)

Purandar: $y = -0.1318x + 10.700$….(8)

Jhorkhali-4: $y = -0.077x + 8.715$……(9)

The slopes of the equations indicate change of level of education according to age and intercept values stand for threshold values of this change. Higher threshold implies the increase in the level of educational status. The negative association between age and education signifies the increase of education with the successive generations. It is clear that the progress of education is highest in Purandar village, thereafter in Jhorkhali-4 and Bhangankhali respectively. On the other hand, intercept values ground the same result with higher loading in Purandar followed by Jhorkhali-4 and Bhangankhali. All these results confirm that the changing scenario of education plays a crucial role in the decision-making process, especially for the new generation. In Purandar presently, new generation prefers to commence their professional life at the non-aquatic sectors considering different odds in aquatic occupations. Their education level is now sufficient to adjust with the urban life. This change intensifies the gradual migration of younger generation to the urban areas for better employment opportunities. This migration strategy helps to increase total family income and subsequently transforms life style of people. This chain migration becomes a very popular livelihood strategy which in turn alters the attitude and emotional value of the households. The analysis enlightens that physical determinism is very

prominent in Purandar in terms of shock and seasonality of livelihoods. At the same time, the increasing level of awareness and consciousness amplify the influence of cultural determinism.

In the context of occupational mobility, Jhorkhali-4 occupies an intermediate position. Direct field inquiry reveals that the bulk of younger generation has moved on to terrestrial occupations. Over the last five to seven years young male members of the families adopt migration strategy; however its intensity is relatively lower than Purandar. In the milieu of physical determinism different aspects play optimistic role to uphold the aquatic livelihoods. Fisherfolk of this village has higher capacity to adopt risk (human capital) and resource availability is substantial (seasonality). The fishing environment of Jhorkhali-4 is the strongest among all the villages in Basanti block (trend). However, uncertainty of life and yields are the important downsides to sustain the livelihood smoothly (shock). Apart from this, sound progress in education status (slope value -0.077, intercept 8.715) increases educational consciousness (trend) which checks drops out of students. Children of school going age now devote them completely in their school education. This change in education level in one hand is increasing consciousness level and on the other hand alters the mind set up. Younger generation does not like to stay in their traditional economy. Considering all these positive and negative aspects, Jhorkhali maintains a balanced equilibrium state.

In different stages of livelihood dynamics Bhangankhali stays almost in a static position since for the two decades. Different physical and non-physical factors directly or indirectly influence the decision making process of the fisherfolk. It has already been assumed that fisherfolk of Bhangankhali have low ability to take the risk (human capital) and at the same time access to resource base (natural capital) is limited for its distant location from the confluence of Matla river. So, they pursue their fishing operation in local rivers and do not venture in deep river fishing. This adoption gives them a little return; but they can avoid facing the problems of uncertain yields (seasonality). This adaptation permanently inhabits them to adjust with subsistence economy, however they do not adopt migration strategy due to some socio-cultural constrains. It has already been proved that educational progress (trend) of this village is very imperceptible (slope -0.0360, intercept 3.296). Field investigation reveals that approximately all young population are first generation learners in this village. Being economically backward, children of fisherfolk help their parents in fishing activities and ultimately are settled in it. In

maximum cases, they stop their education prior to their admission in a higher secondary school. This drop out scenario is not always economically manifested, rather partly due to their religious background. A lion share of fisherfolk in Bhangankhali belongs to the Muslim religion (endogenous item). In India, educational awareness and consciousness among Muslims population are very poor (Basant, 2012). Poor Muslim families sent their children to work in stead of attending school. This trend exists in Bhangankhali too and so it shows lower educational status. Hence, neither they engage in labour works nor adopt migration strategy to meet the survival. They like to persist in their traditional economy. Thus, analysis reveals that physical environment plays a crucial role in modifying the decisions of the fisherfolk. Only their low risk taking capability is responsible in doing so. In another side they decide to settle in their tradition as they are bounded by limited knowledge. This barrier signifies the downside of their socio-cultural background which imperceptibly is the manifestation of cultural determinism.

1.8 Conclusion

The whole investigation started with the appalling trend of livelihood changes within the last two decades and simultaneously it focuses on the changing dimension of man-resource relationship. This prompted the inquiry to take a look at the occupational shifting over the last two decades. After a detailed investigation two important outcomes have been found out. **Firstly**, occupational mobility is notably determined by human choices and social obligations, rather than environmental stimuli. **Secondly**, spatiality is the mainstay of proposed inquiry, so the response of fishing villages relating occupational shifting is very pertinent to look into the nature of dynamics. The fishing villages in different locale exhibit varying responses of livelihood dynamics throughout the whole investigation. Such an outcome is the manifestation of having differential status of livelihood assets and livelihood contexts, which eventually frames varying form of livelihood dynamics.

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