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## Na Gwran: A traditionally prepared smoke dried fish of among tribal community in Kokrajhar district of Assam: Problems and prospects

**Porna Sarmah, Dipanka Saikia and Pooja Basumatary**

### Abstract

Smoking method of fish preservation was known since time immemorial. Smoke fish contains volatile aromatic substances and gives specific features to fish flesh in terms of appearance, color, flavor, and aroma and also add bactericidal effect. Smoked fish, a flavorful and nutritious dried fish product is ready to use with or without further cooking or processing. Na Gwran (Dried or smoked fish) is an integral part of Bodo cuisine. The quality of Na Gwran depends upon many factors such as species, fish size, fish diet, condition, and treatment before and after smoking. Although it was prepared from almost all kinds of locally available fishes by smoke-drying for 2-3 days depending on heating temperature, climatic condition, and fish size. The unique features like quality, taste, off-season availability and increased shelf life will give ample scope to cater market. At present Na Gwran sold at Rs.1000-1200 /kg.

Hence, the present study was undertaken to document Na Gwran, the age-old techniques of fish preservation through smoking. Changing consumption patterns, emerging market force, and technological development through packaging with increase shelf-life will open up new employment avenues to rural youth especially to the most vulnerable section of the society particularly womenfolk.

**Keywords:** Smoke, smoked fish, ethnic food, na gwran, fish

### Introduction

The Northeast region of India is one of the global hotspots for fish biodiversity in the world (Kottelat M & Whitten, 1996) <sup>[1]</sup>. The state of Assam has an excellent sub-tropical climate for the development of fish culture in varied aquatic bodies. Further, the BTR (Bodoland Territorial region) of the Indian state of Assam comprising of 4 districts viz Kokrajhar, Chirang, Baksa, and Udalguri (Figure 1) enriched with the number of water bodies covering an area of 1558 hectares of registered beels, 900 hectares of unregistered beels and swamps, 2334 hectare pond and tank and 671 hectares of wasteland area. The total demand for fish in Kokrajhar district was estimated at 31680 tonnes in 2019-20 and supply was only 20079 tonnes (Chakraborty S *et al*, 2016) <sup>[2]</sup>. However, the district is endowed with myriads of rivers, ponds, and beels which in turn a house of varieties of fish species. It not only supports nutrition to the diet but also adds to the rural economy of the district as rice and fish are two main food components of the state (Swargiary P, 2015) <sup>[3]</sup>. Fish is one of the essential parts of Bodo cuisine and most people of the region consume fish daily as one of the proteinous diets, and hence the demand is very high and increasing considerably.

There are 77 varieties of fish found in the Kokrajhar district which were categorized in 53 genera, 26 families, and 9 order (Chakraborty S *et al*. 2016) <sup>[2]</sup>. Although fish are known as highly perishable food in nature due to biological composition. The shelf life of these products was limited by enzymatic and microbiological spoilage under normal refrigerated storage conditions. To increase the shelf life of this perishable product freezing, drying or smoking is the only option. Most of the people in the district were resides in far-flung remote areas and are belongs to the below poverty line, thus refrigeration was a distinct dream for them. Hence, whenever the excess fish was harvested, they usually preserved the fish with the traditional method of sun drying or smoking. The smoking of fish was practiced since time immemorial and was an age-old tradition of fish preservation. The smoked fish was cooked with organic edible leaves and served as one of the delicacy food among the Bodo community.

The smoked fish 'Na Gwran' was one of the popular methods of fish preservation in the district, especially among the Bodo community. In vernacular terms 'Na' refers to fish in Bodo and 'Gwran' means dried/smoked.

The least presence of unpleasant smell in comparison with other dried fish available in the market makes it more preferable to other communities. Thus Na Gwran opens up ample employment opportunities to unemployed rural youth especially the most vulnerable section of the society i.e women folk through proper packaging with increased shelf life. Hence, considering the present market trend of fish preservation the present study was carried out to document the traditional method of fish preservation Na Gwran and strengthen livelihood security to the rural community.

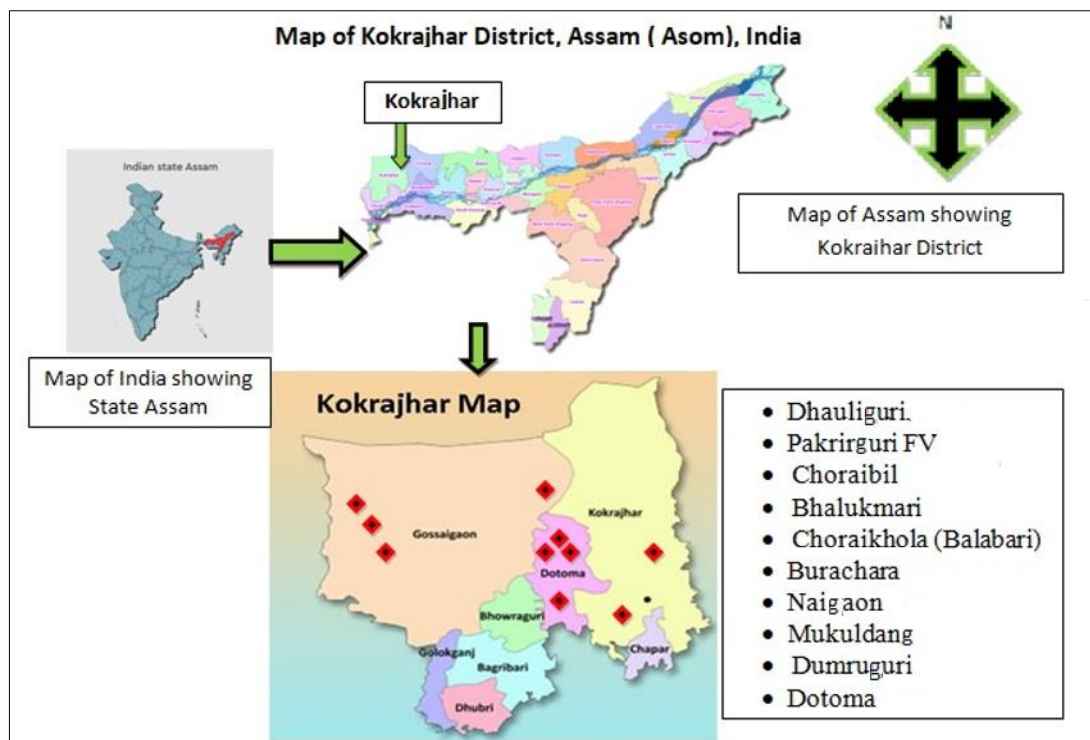
**Methodology**

The methodology section outlines the plan and method to conduct the research study. This includes sample and location of the study, data and source of data, and analytical framework which are as follows.

**Sample and location of the study:** Kokrajhar is one of the 33 districts of Assam and is located in the western most district of Assam sharing an international border with Bhutan in the North and state boundary with West Bengal in the west and is the gateway to Northeast India. The district is located on the north bank of the mighty Brahmaputra lies roughly within 26°19' - 26°54' North and 89°46' - 90°38' East. Like most of the districts of Assam, Kokrajhar is also rich in fisheries resources in terms of Rivers and Wetlands. The Diplai Beel flank is the world's only Golden Langur Sanctuary viz.

Chakrashila Wildlife Sanctuary. It is a large water body that is not only a storehouse of valuable flora and fauna especially fishes but also the prime wintering habitat for a large number of migratory birds (Brahma P *et al*, 2013) [4]. Likewise, Haloidol beel, Gour beel, Gaurang River originating from Bhutan traverses are very rich in natural flora and fauna. The Diplai beel itself witnesses a total of 67 species of fishes have been recorded from the study site belonging to 49 genera, 25 families, and 8 orders (Singha N *et. al*, 2017) [5].

To study the traditional method of preservation of fish through smoking i.e preparation of Na Gwran sample village have been selected based on dispersion and proportion of fish harvested farm families, the intensity of fish preservation done through smoking, type of method followed for fish preservation, caste, and composition of the village, the span of fish preservation practiced and extent of responsive and progressive promptness of the people. Keeping these factors under consideration 10 Bodo-dominated (ST) villages were adopted for the study where intensive fish preservation was carried out viz Dhauliguri, Pakrigruri FV, Choraibil, Bhalukmari, Choraikhola (Balabari), Burachara, Naigaon, Mukuldang, Dumruguri, Dotoma (Fig 1). In addition, to know the marketing trend 10 numbers of daily and weekly markets of Gossaigaon, Dotma, Kachugaon, and Balajan block of Kokrajhar district was selected and presented in Table 1.



**Fig 1:** Study Area of Kokrajhar District, Assam, India

**Table 1:** Details of markets surveyed for dry fish

Sl. No.	Block	Market
1	Gossaigaon	Gossaigaon Tiniali daily market
2	Gossaigaon	Pismatha daily market
3	Gossaigaon	Kasiabari weekly market
4	Dotma	Balanga daily market
5	Dotma	Batabari daily market
6	Dotma	Dotma daily market
7	Balajan	Karigaon weekly market
8	Balajan	Dekhrub daily market
9	Balajan	Balagaon tiniali daily market
10	Kachugaon	Kachugaon Bazar

**Data and source of Data:** The qualitative and quantitative data were collected through personal observation, interpersonal communication. The informal interview was also carried out with elderly and old aged people in villages to know the traditional method of preparation of Na Gwran practiced since time immemorial. Interpersonal communication was carried out through a structured schedule via the mean of the survey from the identified village respondent and market survey. First-hand data of educational qualification, age, sex, the income of the dry fish sellers; the price of various dry fishes were collected to analyze the socio-economic condition of retail Na Gwran sellers.

**Data Analysis method:** In the present study, data were analyzed in two stages i.e at production technology and marketing/ business feasibility of Na Gwran.

**For Production technology:** Data were collected from 10 selected Bodo-dominated ST villages from where 100 respondents were selected and the method of preparation of Na Gwran was analyzed in terms of moisture content, drying rate, moisture ratio, weight measurement, and sensory evaluation in 9 point hedonic scale (Sengar S.H *et al*, 2009)<sup>[6]</sup>

**Moisture Content:** The moisture ratio was computed by initial moisture content (IMC) and equilibrium moisture content (EMC) and analyzed by using the formulae

$$\text{Moisture Content \% (before drying, b. d)} = \frac{(W_1 - W_2) \times 100}{W_1} \quad (1)$$

$$\text{Moisture Content \% (after drying, a. d)} = \frac{(W_1 - W_2) \times 100}{W_2} \quad (2)$$

Where

W1= Weight of sample before drying

W2= Weight of bone dried sample

**Drying rate:** The drying rate of fish per gram per hour per 100 gram of bone dry weight

$$\text{Drying rate} = \frac{W \text{ (Weight loss in one hour)}}{T \text{ (difference in Time reading in hours)}} \quad (3)$$

T (difference in Time reading in hours)

**Moisture Ratio:** The moisture ratio was computed by initial moisture content (IMC) and equilibrium moisture content (EMC) and analyzed by using the formulae:

$$\text{Moisture Ratio} = \frac{(M - M_e)}{(M_o - M_e)} \quad (4)$$

Where

M= Moisture Content

M<sub>o</sub>= Initial moisture content

M<sub>e</sub>= Equilibrium Moisture Content

**Weight measurement:** Moisture removal rate was calculated by taking 1000 gram of sample among the commodity and measured using weighing balance up to 10 milligram accuracy.

**Sensory evaluation:** The sensory evaluation of Na Gwran

was calculated with 9 point hedonic scale.

**Table 2:** Nine point hedonic scale for sensory evaluation

Grade	Score	Grade	Score
Like extremely	9	Dislike slightly	4
Like very much	8	Dislike moderately	3
Like moderately	7	Dislike very much	2
Like slightly	6	Dislike extremely	1
Neither like nor dislike	5		

Sensory evaluation of different organoleptic properties of smoked fish namely texture, color, smell, and overall acceptability of fish was carried out by a panel of 10 numbers of judges on the basis of 9 points hedonic scale (Rangaswamy R., 2002)<sup>[7]</sup> as shown in Table 2. The ranks were determined by the number given by the judges and most and least accepted treatments were pointed out on the basis of organoleptic properties of Na Gwran.

**For business feasibility:**

For business feasibility was calculated from data collected from 10 markets includes formulas or business analytical calculation which includes the total cost of production, total revenue, total profit, and R: C.

Calculation of total cost of production (Sengar S. H *et al*, 2009)<sup>[6]</sup>

$$\text{TC (Total Cost of production)} = \text{TFC} + \text{TVC} \quad (5)$$

Where

TFC = Total fixed cost

TVC = Total variable cost

**Calculation of Total revenue collected**

$$\text{TR (Total Revenue)} = P \times Q \quad (6)$$

Where

P = Price of smoke fish, Rs per Kg)

Q= Quantity per amount of Smoked fish)

**Calculation of total profit**

$$\pi(\text{Total profit}) = \text{TR}(\text{Total revenue}) - \text{TC}(\text{Total cost}) \quad (7)$$

Where

TR = Total revenue.

TC = Total cost.

**Calculation of Revenue cost ratio**

$$\text{R/C} = \text{TR}(\text{Total revenue}) / \text{TC}(\text{Total cost}) \quad (8)$$

With criteria

R:C ≥ 1 Profitable business

R:C = 1 Business break even

R:C ≤ 1 Business Loss

For accessing the efficacy of the data collected, a comparative study will be carried out and plotted in tabular or graphical forms. Secondary data were collected from secondary sources to supplement and strengthen the field data. The major source of these data includes research findings, books, periodicals, census, departmental reports, documents, and field records.

## Result and Discussion

### Production technology of 'Na Gwran'

Na Gwran smoke fish processing and preservation technology in Kokrajhar district still carry the traditional method of smoking. Based on the data obtained from 10 villages with 100 respondents were found using traditional technology which was passed from one generation to another generation. No processors have been found using a modern smoking process like a smoke cabinet or aqueous smoke.

The smoking of fish was done with traditional chulah made from brick and mud structures measuring 1.5 m (length) X 1 m (breadth) X 0.5 m (height). At the top of chulah about 1.5-2 feet height from ground level, one buffer was made with

iron/bamboo stick or sometimes found hanged bamboo or wire mesh sieve to smoke fish.

For the preparation of Na Gwran respondents collect or harvest fish from ponds, beels, rivers, and wetland or shallow waterbed areas by using various fish harvesting tools as shown in Table 3. The harvesting tools were used traditionally by the various community in the district and were usually made from jati (local) bamboo. The utilization of different harvesting tools was depended upon the type of fish harvested, area of use. The different harvesting tools were seen in Bodo villages were Jakoi (Figure 2a), Khaloi (Figure 2b), Chepa (Figure 2c), Julki (Figure 2d), Khosa (Figure 2e), Serai, Dorka (Figure 2f).

**Table 3:** Different fish harvesting tools and its utilization

Vernacular name		Description of harvesting tools	Utilization
Assamese	Bodo		
Jakoi	Jekhai	Wicker work shovel which was made from bamboo and almost 3 dimensional triangular shape bamboo mesh structure	drag or place at the water bed bottom to catch small fish
Khaloi	Khobai	Pitcher like structure and made from bamboo	Tied at the waist and harvested small fish were kept temporarily
Chepa	Sen	A hallow flat cylinder like structure made from bamboo	Use to trap fish. Once the fish entered to the trap were unable to escape from it.
Julki/Polo	Folo	dome shaped bamboo structure	Used in shallow water and technique is almost same as cheap
Khosa	Khosa	Sharp iron nail like structure tied in a bunch with long handle	Use to trap and hurt fish.
Serai	Sairah	Look like basket made from bamboo	Placed at uneven water bed or rice field
Khoka	Dorka	Look like hollow long cylinder structure which was wide at bottom and narrow at top	Use in flowing water like river, rice field



**Fig 2:** Fish harvesting tools a) Jakoi, b) Khaloi, c) Chepa d) Julki e)Khosa f) Dorka

The ethnic cuisine of Bodo community Na Gwran was traditionally prepared from varieties of small fishes and shellfishes including various high-valued fishes such as

Singhi, Tengra, Snack head, Prawn etc. The list of fish used in the preparation of smoke fish was shown in Table 4.

**Table 4:** Showing the diversity of fishes use in terms of taxonomic characteristics and vernacular names in preparation of Na Gwran in Kokrajhar district

Order	Family	Vernacular Name		Scientific name
		Assamese	Bodo	
Cypriniformes	Cobitidae	Bagh mash	Lokra Na	<i>Botia dario</i>
		Batia/ Balibata	Bala Batri	<i>Lepidocephalichthys guntea</i>
	Cyprinidae	Dorikona	Donkina	<i>Rasbora daniconius</i>
		Mola	Mawa	<i>Amblypharyngodon mola</i>
		Puthi	Pitikri	<i>Puntius sophore</i>
		Puthi	Chinese Pitikri	<i>Pethia ticto</i>
Perchiformes	Ambassidae	Chanda	Sanda	<i>Parambassis ranga</i>
		Chanda	Sanda	<i>Chanda nama</i>
	Badidae	Doom vesseli	-	<i>Badis badis</i>
	Gobiidae	Patimutura/ Hasumutra	Hasimutra	<i>Glossogobius giuris</i>
	Anabantidae	Kawoi	Koi/Kawai	<i>Anabas testudineus</i>
	Channidae	Cheng	Nasrai/ Nasrai Nisla	<i>Channa gachua</i>
		Goroi	Gwri	<i>Channa punctatus</i>
Osphronemidae	Kholihona	Kholikana	<i>Trichogaster fasciata</i>	
	Kholihona	Kholikana	<i>Trichogaster lalius</i>	
Siluriformes	Bagridae	Singora	-	<i>Mystus vittatus</i>
		Tengra	Tangra	<i>Mystus tengara</i>
	Heteropneustidae	Singhi	Singi	<i>Heteropneustes fossilis</i>
	Claridae	Magur	Magur	<i>Clarias magur</i>
Synbranchiformes	Mastacembelidae	Turi	Thuri	<i>Macrognathus aral</i>
		Turi	Thuri	<i>Macrognathus pancalus</i>
		Bami/ Gosi	Bami	<i>Mastacembelus armatus</i>
Beloniformes	Belonidae	Kokila	Tota	<i>Xenentodon cancila</i>
Clupeiformes	Clupeidae	Karati	Korti	<i>Gudusia chapra</i>
Decapoda	Palaemonidae	Junai	Nathur Junai	<i>Macrobrachium Assamensis</i>

### Steps in preparation of Na Gwran

The preparations of Na Gwran in the traditional method was very simple and were shown in the following steps:

1. Preparation of raw materials includes cleaning of fish 2-3 times in fresh normal water to remove dirt and organic debris.
2. Weeding of fish is done by de-scaling and degutting by removing non-edible parts like scale gills, guts, etc.
3. De-scaled and degutting of fish is avoided in case of small fish to maintain the texture and shape of fish.
4. Fish are again cleaned 2-3times in cold water for complete cleaning.
5. In the case of small Prawn (*Macrobrachium Assamensis*) de-heading and descaling are not practiced, the whole

6. Clean fish are spread over Bamboo ('Sandri' in Bodo and 'Chaloni' in Assamese) or wire mesh sieve and hanged over Firewood chulah ('Okdab' in Bodo and 'Chauka' in Assamese) at a height of 1.5 to 2 feet. (Figure 3i)
7. The process of smoking is continued for 2-3 days based on the size of the fish and moisture content of the fish.
8. The smoked fish is dried completely and is stored in an airtight container. Frequent monitoring of the container is carried out from time to time to check fungal growth or spoilage. Sun drying of smoked fish is practiced periodically to restrict the growth of fungi or any spoilage.



**Fig 3i:** Process of making Na Gwran a) raw fish b) Partially dried fish c) Smoked fish



**Fig 3ii:** Preparation of Na Gwran from prawn a) raw fish b) smoking c) smoked fish

**Production of Smoke**

Smoke is produced through heating and is a basic component responsible for the smoking of fish. The composition and properties of smoke depend upon the type of wood, chemical composition, physical properties, and burning conditions. Wood from deciduous trees such as Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), Gamari (*Gmelina Arborea*), Sal (*Shorea robusta*), Segun (*Tectona grandis*) was used for drying of fish. The humidity of wood used for smoking should not exceed 25%. Smoked fish with unattractive color and bitter taste of resin is obtained if the humidity of raw wood is more than 50% (Belichovska K *et al.* 2019)<sup>[8]</sup>.

**Quality assessment of ‘Na Gwran’**

Moisture content, drying rate, moisture ratio, weight measurement, and sensory evaluation were the contributing factors that directly determine the shelf life and overall quality of Na Gwran.

**Moisture Content**

The moisture content of the smoked fish was calculated as initial moisture content before smoking was found 75.9% in 100 gm of fish and after smoking, it was dried up to 16% moisture content which in turn increased the shelf life by preventing bacterial activity and spoilage (Ali A *et. al.*, 2011)<sup>[9]</sup>.

**Drying rate**

It was found that the total heat required to evaporate the moisture content inside the fish was solely dependent upon size, the quantity of fish, and moisture present in wood used to create heat. However, the drying rate of small fish like prawn was found as 11% that of slightly bigger size fish 14-

16%.

**Sensory evaluation**

Smoked fish was mostly liked due to its color, texture, and absence of unpleasant smell whereas sun-dried fishes were moderately liked, and fermented fish was least liked due to its unpleasant smell, color, and overall texture.

**Business feasibility analysis of Na Gwran**

It was found and observed that the majority of the Bodo household prepare Na Gwran for domestic consumption only and a key ingredient and food of delicacy known as *Napham*. It was also seen that a variety of ethnic recipes were prepared from Na Gwran, *Napham* and *Natur Junai* (smoked dried prawn) in combination with different organic leafy and non-leafy vegetables added to nutrition in their diet *viz.* Potato, Tomato, Jack fruit, Taro leaves (*Colocasia esculenta*), Roselle leaves (*Hibiscus Sabdariffa*), Sorrel leaves (*Rumex Acetosa*), *Jwglaoiri* leaves (*Plectranthus Ternifolius*), Bamboo shoot (young sprout of *Bambusa spp*), etc. It was also observed that a surplus quantity of Na Gwran was sold in local vendors by women to support better livelihood security (Boro A, 2018)<sup>[10]</sup>. The market value of Na Gwran in the local market was ranged from Rs. 1000.00- Rs. 1200.00 per kg, although the price was found fluctuating and a little higher if sold during the offseason.

Evaluation of the business feasibility of Na Gwran was initiated by surveying 10 marketing outlets of the district. Their Socioeconomic status was collected in a pre-structured questionnaire and data were analyzed on the basis of age of doing retailing business; education level; family size; quantity sold per day and total profit earned which were presented in Table-5.

**Table 5:** Socio economic status of retailer

	Parameters	Number of respondent	Percentage %
Age group	20-30	3	16.67
	30-40	6	33.33
	40-50	2	11.11
	>50	7	38.89
Level of education	Illiterate- Primary	7	38.89
	Intermediate	8	44.44
	HS	3	16.67
	Graduate or above	-	-
Family size	1-5	12	66.67
	5-10	6	33.33
	>10	-	-
Quantity sold per day	0- 200 gm	6	33.33
	200-500 gm	3	16.67
	500gm-1 kg	5	27.78
	1-2 kg	2	11.11

	>2 kg	2	11.11
Income	Rs. 0-200	9	50.00
	Rs. 200-500	6	33.33
	Rs. 500-1000	2	11.11
	Rs. 1000-2000	1	5.56
	>2000	-	-

It was found that marketing of Na Gwran was mainly done by Bodo women aged between 30-40 and above 50 age-old (Figure 4). They sold at least 100 gm to 500 gm of Na Gwran

daily and wisely support their family to some extent.



**Fig 4:** Marketing of Na Gwran by women in market.

**Economic and business feasibility of Na Gwran**

The total cost of production was calculated by the total cost involved in fixed cost plus cost involved in the purchase of variables which includes the purchase of raw materials as fish; labor involved, fuel, transportation, and packaging cost.

Further, total profit was calculated as total income minus the total cost of production as shown in Table 6. Hence, it was clearly found that the business feasibility of Na Gwran was good and will be increased subsequently with modernized techniques of packaging and value-added products.

**Table 6:** Business analysis of Na Gwran

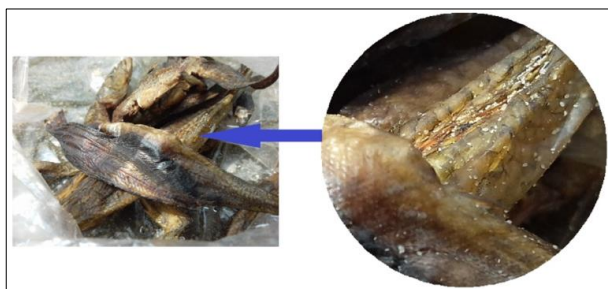
Number	Description	Unit	Volume	Price	Amount
<b>A</b>	<b>Investment cost</b>				
1	Smoke Chulah	1	Unit		300.00
2	Equipments/Utensils	2	Set		400.00
Total A					700.00
<b>B</b>	<b>Variable Cost</b>				
1	Raw fish	10	Kg	200.00	2000.00
2	Labour	2	Person	300.00	600.00
3	Fuel cost	1	<i>Thella</i>	300.00	300.00
4	Transportation cost	1	Package	200.00	200.00
5	Packaging cost	1	Package	200.00	200.00
Total B					3300.00
<b>C</b>	<b>Fixed cost</b>				
1	Chullah depreciation cost				100.00
2	Equipment depreciation Cost				100.00
Total C					200.00
Total cost of Production (B + C)					3500.00
<b>Income</b>					
	Smoked fish product	7	Kg	1200.00	8400.00
<b>Profit (Income – Total production cost)</b>					
Daily					170.00
Monthly					5100.00
R/C ratio					1.54

**Problems and prospects of ‘Na Gwran’**

The Shelf life of Na Gwran was a cause of concern as it was found spoiled during the monsoon or rainy season due to

insect infestation (Figure 5). Dried fishery products frequently suffer severe losses due to infestation by flesh flies (*Sarcophagidae*), beetles (*Dermestes*, *Cornestes*) and

*Necrobia spp.*) And mites (*Lardoglyphus* and *Lyrophagus spp.*) (Singh S. *et al*, 2018) <sup>[11]</sup> were also reported by the respondent.



**Fig 5:** Insect infestation in Na Gwran due to improper packaging

### Conclusion

‘Na Gwran’ refers to smoked fish was known as an integral part of Bodo ethnic cuisine. The tradition of food and fish preservation was passed from ancestors to younger generations and was practiced since time immemorial. It gains its popularity due to the absence of unpleasant odor in comparison with other dried or fermented fish available in and outside the state. Although the quality of smoked fish significantly depends upon the moisture content, the firewood used, drying rate, color, texture, smell, and shelf life restrict the growth of microorganisms or fungus. The unique technique of drying or smoking fish was rare and popular among the Bodo community of this region. The absence of unpleasant smell caters to its preference to other communities also and thus opens up new employment opportunities. Further, the business feasibility of Na Gwran was found cost-effective and profitable. The demands were found to be increased if modern technology of smoking were incorporated to increase the shelf life of the smoked fish. Proper processing, packaging, and value addition add to increase the shelf life of Na Gwran. Hence, the popularization and marketing of Na Gwran offers ample opportunities to unemployed rural youth especially to the most vulnerable section of the society i.e. women, and thus provide livelihood security to some extent.

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### Conflict of Interest

The authors declare no competition and conflict of interest.

### Author’s Contribution Statement

DS: Convinced concept, carried out data collection, photography, prepared manuscript and prepare tentative draft.  
PS: Convinced concept, carried out data collection, photography, prepared manuscript and prepare original draft of the study; PB: field level data collection, manuscript preparation and editing.

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