

Exploring the status of ethnic tribal value addition practices of Jackfruit (*Artocarpus heterophyllus* Lam.) in Garo Hills of Meghalaya, India

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Jackfruit gets wasted to the tune of \$5.8 million every year from 0.4-0.5 million jackfruit trees in Garo Hills due to lack of suitable infrastructure, limited scientific know-how regarding processing and storage, and restricted market access. The study aims to explore the status of jackfruit cultivation and utilisation of locally available jackfruit and to document the value addition practices followed by ethnic tribal communities in the Garo Hills of Meghalaya, India, to augment the standardisation of the sustainable value addition practices for the region. The study was conducted in all five districts of Garo Hills. Two blocks from each district were selected through a simple random sampling method. Twenty respondents from each selected block were selected through the snowball sampling method, thereby making a total of 200 respondents. Identification and documentation of ethnic value addition practices of tribal communities were done through Focused Group Discussion with the relevant stakeholders. Data were analysed with descriptive statistics and Duncan Multiple Range Test. The average wastage percentage was more than half of the jackfruit production in Garo Hills, as very few respondents (30.5%) engaged in value addition practices and due to negligible marketing of raw jackfruit (3970 kg). Identification, documentation of ethnic value addition practices, and their utilisation study provide a clear indication of the need for standardisation of these value addition practices through laboratory research to benefit the local demand and outside market as well.

Keywords: Ethnic practices, Garo Hills, Jackfruit, Utilisation pattern, Value addition

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The Garo Hills region of Meghalaya, like other Northeastern states of India, is richly blessed with the sub-tropical to the tropical climate, which favours the growth of many fruit crops of horticultural importance¹. But a vast majority of these natural resources have remained either unutilised or under-utilised to their full potential². Jackfruit (*Artocarpus heterophyllus* Lam.) is one such fruit tree, available in plenty in Garo Hills of the Northeastern state of Meghalaya, India³, and grows naturally due to favourable agro-climatic situation. It is not uncommon to find ripe jackfruits rotting on the trees during the peak fruiting season. Jackfruit could be used as an important source of nutrition for the masses and could fetch additional income for the household as well if it is used to its full potential⁴. The jackfruit gets wasted to the tune of Rs. 4.34 billion (\$5.8 million) every year from 0.4-0.5 million

jackfruit trees in Garo Hills due to lack of suitable infrastructure, restricted market access, and limited scientific know-how regarding processing and storage⁵. Understanding the potential of the fruit, the Government of Meghalaya started 'Mission Jackfruit' in August 2018 to promote the value addition of jackfruit among the farmers⁵. The Mission encourages the processing of jackfruit so that it can open up avenues of opportunities to the potential entrepreneurs in the value chain, especially women⁵.

It was observed that the value addition of jackfruit helps the rural masses to generate income and employment opportunities, especially for the women⁶. This also helps minimise wastage of the fruit and makes it available throughout the year. Jackfruit is a multi-purpose species, as it can provide food, timber, fuel, fodder, medicinal, and industrial products⁷⁻⁹. Despite richness in nutritive content, multiple usages, and easy availability, jackfruit has remained underutilised, and its potential still remains to be fully

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exploited. Jackfruit is grown in all the districts of Garo Hills, mostly in homestead gardens. But, there has been no record of any grower following the scientific method of cultivation or on a commercial scale in the region. Jackfruit has been a part of Garo culture from time immemorial, and it is used as food, fodder, timber, and medicine¹⁰. Therefore, it is very important to promote the value addition of jackfruit by the local growers. The ethnic value addition practices followed by the Garos are unique and deserve to be promoted, encouraged, and documented for the benefit of posterity.

Against this backdrop, the study aims to explore the status of jackfruit cultivation and utilisation of locally available jackfruit, and to document the value addition practices followed by ethnic tribal communities in Garo Hills of Meghalaya, India, for augmenting the standardisation of sustainable value addition practices for the region.

Materials and Methods

Study area

The Garo Hills is located on the western part of Meghalaya and lies approximately between 89°49'E - 91°2'E Longitude and 25°9'N - 26°1' N Latitude with the elevation ranging from 100 to 1500 m from average mean sea level^{11,12} (Fig. 1). The Garos are the single largest tribe inhabiting the Garo Hills of

Meghalaya. The Garos belong to the greater Bodo Kachari family of the Tibeto-Burman race and follow matrilineal society^{12,13}. Jackfruit, as a fruit crop naturally grown in Garo Hills, takes an indispensable part in the gross agricultural domestic products besides other major fruit in the region. Jackfruit is generally known as *te.brong* in Garo, but there are different names given to different types of jackfruit that are locally available based on shape, size, taste, and time of availability. *Matchuri* (fruits are elongated), *makkresko* (fruits are small and roundish), *diksang* (fruits are large in size and pot-shaped), *diktom* (fruits are large in size and round in shape), *regittang* (peel colour remains green on ripening), *migimin* (the peel becomes very soft on ripening), *sarang* (early maturing cultivars), and *mimong* (late-maturing cultivars) are some nomenclatures used by the people as revealed by respondents during the study.

Sampling design and data collection

The study was perpetrated in exploratory research design during 2019-20 in the Garo Hills of the Northeastern state of Meghalaya, India (Fig. 1). The study was conducted in all the five districts of Garo Hills, namely, West Garo Hills (WGH), East Garo Hills (EGH), South Garo Hills (SGH), South West Garo Hills (SWG), and North Garo Hills (NGH). Two blocks from each district were selected through

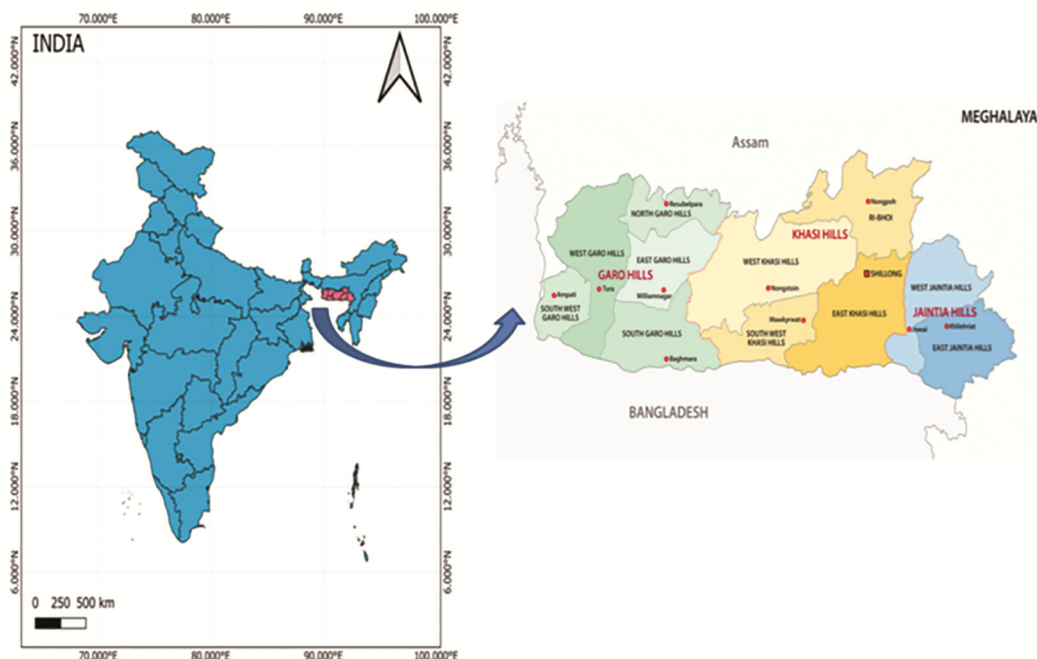


Fig. 1 — Maps showing location of the study area (Source: <https://meghalaya.gov.in/maps>)

simple random sampling method (without replacement). Twenty respondents from each selected block were selected through the snowball sampling method¹⁴, and thereby making a total of 200 respondents from the ten blocks of the five districts of Garo Hills (Table 1). The criteria of selection for snowball sampling were i) respondents should belong to the tribal community, ii) respondents should be residents of Garo Hills for at least ten years, and iii) respondents should have at least one jackfruit tree of the fruit-bearing stage.

Study encompasses the socio-economic perspectives; status of cultivation, utilisation and wastage; and value addition practices of jackfruit by the selected respondents. The study was done with the

help of a semi-structured interview schedule. The different tools used and their measurements are presented in Table 2. The age of the respondents was between 19 and 88 years with a mean value of 48

Table 1 — Distribution of selected blocks

Districts	Blocks	No. of Respondents
West Garo Hills	Rongram	20
	Gambegre	20
East Garo Hills	Samanda	20
	Dambo Rongjeng	20
South Garo Hills	Chokpot	20
	Rongara	20
South West Garo Hills	Betasing	20
	Zikzak	20
North Garo Hills	Bajengdoba	20
	Kharkutta	20
Total		200

Table 2 — Tools used and their measurement

Parameters	Operationalised description	Units of measurement
A. Socio-economic perspectives		
Age	Chronological age of respondents in year	Young-1 (18-39 yrs) / Middle-2 (Above 40-59 yrs) / Old-3 (Above 59 yrs)
Family type	Family status of respondents	Nuclear-1 / Joint-2
Education	Years of formal education	Illiterate-1 (No formal education) / Read and Write-2 / Primary-3 (Std 1-4) / Middle -4 (Std 5-8) Secondary-5 (Std 10) / Higher Secondary-6 (Std. 11-12) / Graduate and above-7
Occupation	The primary occupation of respondents	Agriculture-1/Service-2/Daily Wage- 3 / Housewife-4 /Business-5/Others-6
Farming experience	Total number of years spend in fish culture	Up to 5 years-1 / 6-10 years-2 / 11-20 years-3/Above 20 years-4
Rearing of domestic animal	The status of rearing of domestic animals	Reared-1/ Not reared-2
Annual income	The annual income of the respondents from all sources	Up to Rs. 50,000-1/ Rs. 50,001-Rs. 1,00,000-2/ Rs. 1,00,001-Rs. 1,50,000-3/ Rs. 1,50,001-Rs. 2,00,000-4/Above Rs. 2,00,000-5
B. Status of jackfruit cultivation by respondents		
Number of plants	Total number of jackfruit plants possessed by the respondents	Numerical values is used
Average of age of plants	The total ages of all the plants divided by total numbers of plants	Numerical values in years are used
Total production	Total production of all the plants of the respondents	Numerical values in kilograms are used
Total projected value	Total production is multiplied by Rs.40/- (as the rate of Govt. of Meghalaya is Rs. 40/kg)	Numerical values in INR are used
C. Status of utilisation and wastage of jackfruit		
Average wastage	Average wastages per plant	Numerical values in kilograms are used
Total projected value of wastage	Total wastage is multiplied by Rs. 40/- (as the rate of Govt. of Meghalaya is Rs. 40/kg)	Numerical values in INR are used
Home consumption	Total amount consumed by the family of the respondents at home	Numerical values in kilograms are used
Sale in market	Total sale in retail market by respondent	-Do-
Sale to middlemen	Total sale to middlemen by respondent	-Do-
D. Status of value addition		
Value-added products of jackfruit prepared	Different products prepared by the respondents	Open-ended questions were put
Training received	Training received on jackfruit value-addition by the respondents	Yeas-1/No-2
Sale of value added products	Total sale of value added jack fruit products by the respondents	Yeas-1/No-2

years. The majority (48%) of the respondents were between 40 to 59 years. The average educational status of the respondents was relatively lower, as the majority of them studied up to the high school (34.5%) and middle school (23%) levels (Fig. 2). Different general ethnic practices and value addition practices followed by the ethnic tribal communities in Garo Hills for jackfruit were identified through focused group discussions (FGD). Stakeholders were identified after exhaustive study of different existing literature and in consultation with different secondary sources. Ten FGDs were conducted (two from each district) with the active participations of villagers, farm women, aged people, traditional healers, *Nokmas* (village headman), Self Help Group (SHG) members & NGOs associated with value addition of jackfruit, and other relevant stakeholders in the districts. We encouraged open discussions with focused lead questions on ethnic value addition process and practices in Garo Hills. The identified practices were documented, and their utilisation status by the villagers was studied on 200 sample respondents. The necessary consent was given by the participants to share and publish the different inputs provided by them and the results of the inputs provided by them.

Data were analysed with descriptive statistics like percentages, frequencies, mean, and standard deviation. Duncan Multiple Range Test (DMRT) was

conducted for comparison of the average production potential of each selected district. Identification and documentation of ethnic value addition practices of tribal communities were done through FGDs with the relevant stakeholders in the villages as stated above.

Results

Socio-economic perspective of jackfruit growers

Farming was the main source of livelihood in Garo Hills, as agriculture is the primary occupation of 48% of villagers and 11% were daily wage earners. Most of daily wage earners were also engaged in farming operations as shown in Fig. 2. The average annual income of majority of the respondents (59%) was relatively lower (up to Rs. 50,000), as the majority of the farmers were dependent on primary sectors (agriculture and agri-allied) for the sources of livelihood. Due to the agrarian economy, 82% of respondents had the farming experience of more than twenty years. A considerable number of villagers used to earn their livelihoods from small-scale agri-allied businesses (15.5%) and services (20%) in government or private sectors. The majority of the respondents came from nuclear families (91.5%), while 17 (8.5%) were from joint families (Fig. 2).

The study indicates that SGH district has a high potential for jackfruit cultivation. Table 3 shows that the highest number of jackfruit trees (42.44%) were

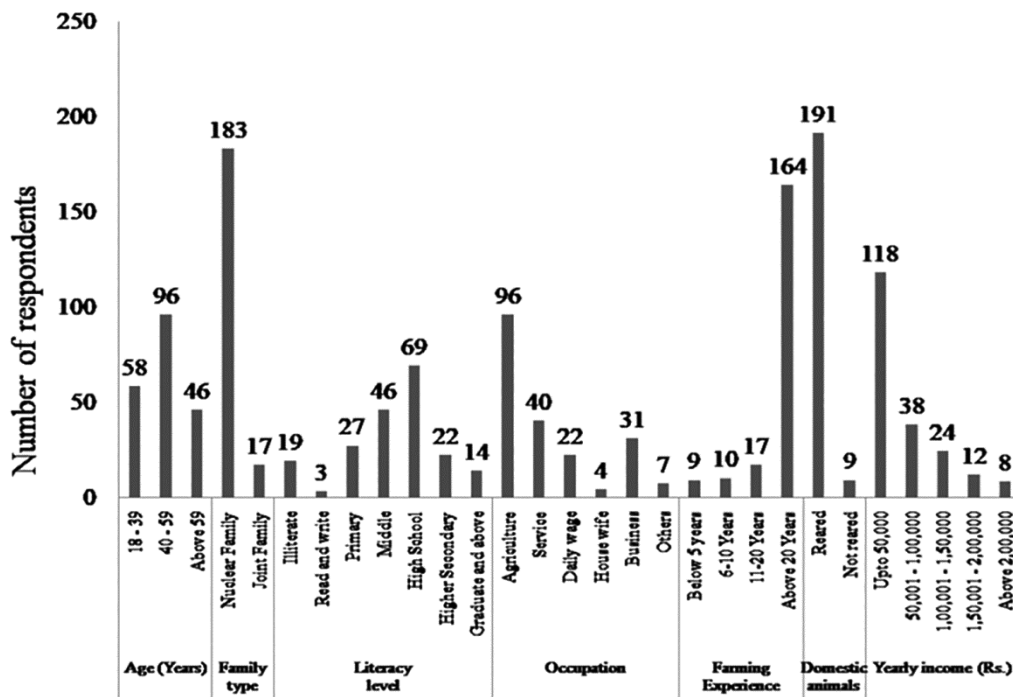


Fig. 2 — Socio-economic perspective of the respondents

Table 3 — Status of jackfruit cultivation by respondents in Garo Hills

District	Name of the blocks	No. of plants	Average of age of plants (Year)	Average of yield / Tree (kg)	Total production (kg)	Total projected value (Rs)*
South Garo Hills	Rongara, Chokpot	668 (42.44%)	27.48	66.72	2,05,625	51,40,625 (\$68,899.80)
South West Garo Hills	Betasing, Zikzak	276 (17.53%)	36.68	60.25	86,875	21,71,875 (\$29,109.64)
West Garo Hills	Gambegre, Rongram	238 (15.12%)	25.15	49.62	64,625	16,15,625 (\$21,654.22)
East Garo Hills	Dambo Rongjeng, Samanda	231 (14.68%)	24.28	58.78	89,925	22,48,125 (\$30,131.62)
North Garo Hills	Kharkutta, Bajengdoba	161 (10.23%)	28.52	69.25	69,795	17,44,875 (\$23,836.56)
Mean value		314.80	28.42	60.92	1,03,369	25,84,225 (\$34,636.37)
Standard deviation		180.46	13.05	6.867	52,033.44	13,00,835.97 (\$17,419.50)

*Taken as Rs. 40/kg of fruit (Meghalaya, 2018); (1\$= Rs. 74.61)

prevalent in SGH district, which was more than double that of the next highest district of SWGH (17.53%) as per the responses of the respondents. The SGH and SWGH districts have an international borderline with Bangladesh, where jackfruit is the national fruit. The average age of plants in the SGH district was also relatively lower (27.48 years) than that of the mean value (28.42 years). But, jackfruit trees were the oldest in the SWGH district (36.68 years) among the five districts in Garo Hills of Meghalaya. Most interestingly, the average yield per tree was highest in the NGH district (69.25 kg), where the number of plants was lowest (10.23%). The next highest average yield per tree was noticed in the SGH district (66.72 kg), whereas the mean value was 60.92 kg. But, total jackfruit production was highest in the SGH district (2,05,625 kg) due to the highest number of plants and relatively higher productivity. It also placed the district at the top in terms of the total projected values (Rs. 51,40,625), which was more than double those of other Garo Hills districts, as evident from Table 3.

Jackfruit production and utilisation pattern

The average price value of the jackfruit at the district level, as stated by the respondents, also indicates that the SGH district was distinctively high (Rs. 25,70,312.5) in generating income among the respondents from the other districts (Fig. 3). The SGH district was followed by WGH (Rs. 14,12,187.5), SWGH (Rs. 8,88,750), NGH (Rs. 8,72,437.5), and EGH (Rs. 7,16,875) districts (Fig. 3). Results of the Duncan Multiple Range Test (DMRT) for comparison of the average production potential of each selected district are given in Table 4. It is clear that the

Table 4 — Multiple comparison of average production of Jackfruit in Garo Hills districts

Districts	Mean Production (In kg)	Statistical Significance*
East Garo Hills	28,675.0	B
North Garo Hills	34,897.5	AB
Southwest Garo Hills	35,550.0	AB
West Garo Hills	56,487.5	AB
South Garo Hills	1,02,812.5	A

*Overlapping letters (AB) indicate non significance at 5% level of significance.

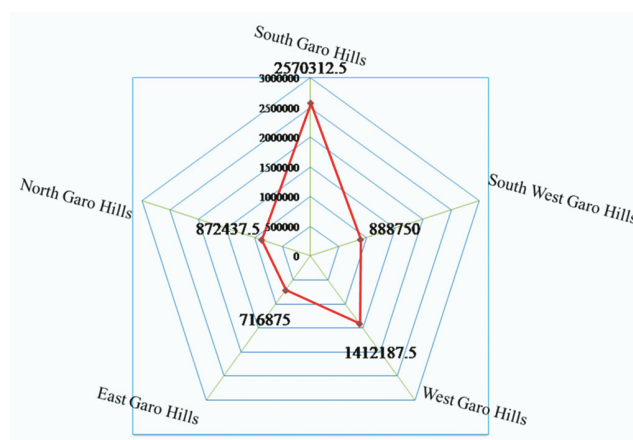


Fig. 3 — Average price value of jackfruit at district level

average production of jackfruit in the SGH district was significantly ($p < 0.05$) higher compared to the average production of EGH district, whereas the average production of other districts was at par with the EGH district.

Status of wastage of jackfruit

The study unfolds that the average wastages of jackfruit were quite high in all the districts of Garo

District	Block	Wastage of fruit			Sale in market		Sale to middlemen		
		*Average Wastage (%)	Approx Wastage (kg)	**Approx. Value (Rs.)	Home consumption (kg)	Tender (kg)	Mature (kg)	Tender (kg)	Mature (kg)
East Garo Hills	Samanda, Dambo Rongjeng	65.47	58,871	14,71,775 (\$19,726.20)	2,837	50	0	0	0
South West Garo Hills	Betasing, Zikzak	53.43	46,419.5	11,60,487.5 (\$15,540.01)	2,076	0	1,450	0	10,800
South Garo Hills	Chokpot, Rongara	57.51	1,18,252.5	29,56,312.5 (\$39,623.46)	2,310	0	0	0	4,250
West Garo Hills	Gambegre, Rongram	59.95	38,745.5	9,68,637.5 (\$12,982.65)	2,436	0	1,000	0	0
North Garo Hills	Kharkutta, Banjengdoba	57.79	40,331.25	10,08,281.25 (\$13,513.99)	2,600	0	0	1,750	550
Mean Value		58.83	60,523.95	15,13,098.65 (\$20,280.06)	2,451.8	10	490	350	3,120
Standard Deviation		3.93	29,719.69	7,42,992.20 (\$9,958.32)	257.65	20	616.77	700	4,155.31

* Percentage of average wastage is calculated on basis of total production in the district given in Table2. ** (1\$= Rs. 74.61)

Hills as ascertained by the respondents, which is supported by a high average mean value of 60,523.95 kg., as evident from Table 5. The average wastages of jackfruit were almost double in the SGH district (1,18,252.5 kg) than those of other districts in Garo Hills though production was also more than double (Table 3) in SGH district. The average wastage percentage, as shown in Table 5 suggests that more than half of the production got wasted (58.83%), amounting to Rs. 15,13,098.65 as respondents could not be able to market a very negligible amount of jackfruit (3,970 kg), which is evident from the mean values. The majority of the marketed jackfruit by the respondents to the middlemen¹⁵ was matured jackfruit with a mean value of 3120 kg. The SWGH district (10,800 kg) and SGH district (4,250 kg) remained on higher sides backed by the higher production. At the same time, the highest wastages in terms of money was in SGH district (Rs. 29,56,312.5), followed by EGH district (Rs. 14,71,775).

Status of local value addition of jackfruit

The study shows that 30.5% (61) of the respondents were engaged in value addition practices, whereas 69.5% (139) of them did not do any type of value addition in jackfruit. Some of the value-added products prepared by the respondents were chips, pickles, wine, jam, jelly, squash, juice, papad, and pakoda. Fig. 4 shows that most of the respondents opted chips and pickles making as value addition practices. Chips and pickle were made by 67.21% (41) and 60.66% (37) of

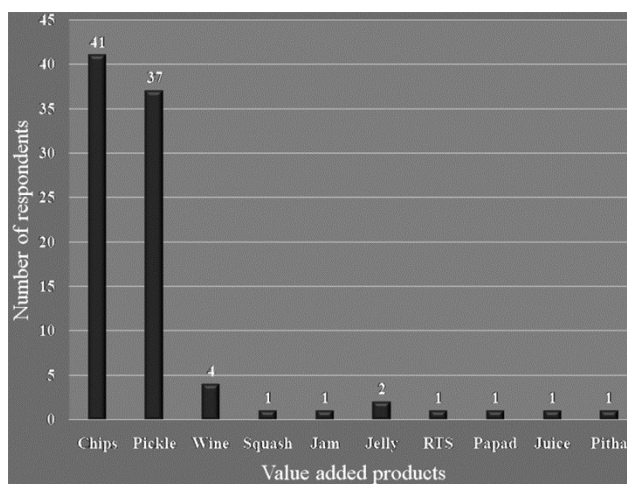


Fig. 4 — Distribution of value-added products of jackfruit prepared by the respondents

the respondents respectively among the respondents, who did value addition practices,

Most interestingly, out of 61 respondents who were practising value addition of jackfruit, only 16.4% (10) respondents received training while the others followed the indigenous method or the methods learned from friends, and only 9.8% (6) of them used to sell the value-added jackfruit products.

Thus, the above results justify the need to assess the status of present local value addition of jackfruit in Garo Hills, to identify and to document the value addition practices followed by ethnic tribal communities in Garo Hills of Meghalaya, India, for standardising sustainable value addition

practices for the region, which are illustrated in the Discussion section.

Ethnic practices in jackfruit

The various ethnic practices in jackfruit followed by the tribal communities in the five districts of Garo

Hills, Meghalaya, identified through FGD, are presented here in Table 6. Different general ethnic practices related to jackfruit and its value addition followed by the ethnic tribal communities in Garo Hills were identified through FGDs with the villagers, farm women, aged people, traditional healers, and

Table 6 — Inventory of ethnic practices in Garo Hills in relation to jackfruit

Usage	Part used	Practice	Percentage of Respondents Using the Practices
General ethnic usage of jackfruits			
Trap for birds	Latex	The latex or gum from the fruit is applied on catch the birds	29.30
To use as laxative	Tender leaves	Wash 2-3 tender leaves, chewing and eating helps in constipation	40.78
As a tonic to lower blood pressure	Matured and tender leaves	Leaves are boiled and the water is then used for drinking	13.25
To bring down blood sugar level in the body	Leaf buds	Tender leaf buds are eaten raw once a day	7.25
Used softening meat	Tender and matured leaves	Both tender and matured leaves are used in cooking meat	8.3
As vegetable	Seed coat of matured fruit	The seed coat is used to cook with roselle (<i>Hibiscus safdariffa</i>). It has the taste of mushroom	2.9
Preserving dry fish	Matured leaves	Jackfruit leaves are used as plugging material in place of lemon leaves in preservation of ground dry fish in bamboo tubes	10.8
Ethnic value-added products and practices			
Chips	Parts used	Practice	
	Bulbs	The spices are mixed with the pieces and then fried in oil. Better absorption of spices by the pieces	16.5
	Bulbs, perigones, seed coat	The pieces are fried lightly, mixed with salt, turmeric, chilli powder and fried again	6.5
	Bulbs and perigones	Bulb pieces and perigones are fried together and salt added directly in oil while frying	1
	Bulbs and perigones	Bulb pieces are fried separately from perigones. Fried pieces are mixed with turmeric, salt and chilli powder and fried in refined oil. Frying separately is done for uniform cooking	5
	Bulbs	Salt mixed with the pieces and fried in oil, and salt and chilli powder added soon after frying	37.50
	Bulbs	Pieces are fried in oil. Salt and spices are not used.	1.8
Pickle	Parts used	Practice	
	Immature fruit	Cut, boiled, dried (4-5 h), mixed with ingredients (jeera, vinegar, <i>panchpuran</i> , garlic, chilli powder, mustard, cooled boiled mustard oil, salt), bottled and dried for one week	12.45
	Immature fruit	Cut to small cubes, boiled in water where turmeric has been added, dried for one day, mixed with ingredients (fried black mustard, fried and coarsely ground <i>jeera</i> , boiled and cooled mustard oil, salt), dried in sun for one week	10.25
	Immature fruit	Cut pieces are boiled to soften, dried in sun for one day, mixed in raw mustard oil, salt and spices (<i>jeera</i> , chilli powder, <i>achar</i> masala, turmeric, salt), dried in sun for one week.	28.75
	Immature fruit	Boiled, dried for 1 or 2 days, mixed with ingredients, raw oil, bottled and dried for few days. Raw oil helps to preserve for longer days	16.38

(Contd.)

Table 6 — Inventory of ethnic practices in Garo Hills in relation to jackfruit (*Contd.*)

Usage	Part used	Practice	Percentage of Respondents Using the Practices
	Immature fruit	Oil is heated, spices are fried in it, pieces either lightly boiled and drenched (or used directly without boiling) and then fried. Enough oil is added and then bottled and stored. If extra oil is to be added, the oil is boiled and cooled first. Cannot be preserved long	7.80
	Immature fruit	Fruit after removal of the outer skin is cut to big pieces and semi boiled for about 10 min, using hand by pulling action the bigger pieces are made into small pieces, oil is heated and ingredients are added to it (<i>panchpuran</i> as whole, mustard seed as whole and ground, garlic as whole, cloves, ginger paste, chilli powder, vinegar), jackfruit pieces are mixed in this and put in containers and sun dried for about 5 days	13.25
	Immature fruit, middle core is not used	Pieced after removing the outer skin are boiled, dried in sun till water is drenched; oil is heated and <i>jeera</i> , ginger, garlic and spices like chilli powder, pickle <i>masala</i> are fried in oil and mixed with fruit pieces, salt is added; the pieces are fried, taken out of fire and vinegar is added	18.62
	Immature fruit	Directly frying the pieces in oil and spices.	52.06
	Immature fruit, core is not used	Pieces are steamed, dried for one hour, oil is heated and allowed to cool a bit and then mixed with the jackfruit pieces and the spices (pickle <i>masala</i> , garlic, ginger, garam <i>masala</i> , <i>panchpuran</i> , asafoetida, vinegar (1 cup/kg) or lemon juice. Alternatively, raw oil is used but sun drying is required	11.25
	Immature fruit core is not used.	Pieces are either boiled or directly fried in oil, in which spices were first lightly fried; meat is also added (meat is first boiled and fried)	9.58
Wine	Part used	Practice	
	Ripe bulb	2 kg bulb in 5 kg water, 3 kg sugar, yeast 2 table spoon, put in bucket and cover, after 2 months filtered using muslin cloth, kept airtight in big bottles and stored	4.46
	Ripe bulb	1 litre capacity bottle is filled with bulbs and mixed with 1.5 cup, kept airtight. Wine is ready in about one week	6.23
	Ripe bulb	Deseeded bulbs are just put airtight in a plastic container. Ready in about one month.	27.84
	Ripe bulb	Deseeded bulbs are boiled with little sugar, cooled and mixed with citric acid and stored. Cannot be preserved long	5.34
Dried bulb	Parts used	Practice	
	Ripe bulb	Deseeded bulbs are opened up and kept over the fireplace for about one week and is then stored in bamboo tubes, similar to preservation of ground dry fish. Leaves of lemon or pomelo are used to plug the mouth of the bamboo tube	6.3
	Ripe bulb	The deseeded bulbs are dried over fire to reduce the water content and then a little vinegar is sprinkled over the pieces and then dried over the fire again; the dried pieces are stored in bottles. Can be preserved up to one year; too much of vinegar should not be used as it will make the taste sour	3.52
Whole fruit preservation	Ripe fruit	Fully ripe fruit is stored over the fire place and the formation of soot on the fruit surface helps to keep the fruit intact. The fruit can be kept intact for 3-4 months	2.13
Pakora	Seeds	The reddish coat is scraped off and the seeds are boiled and then mashed and mixed with ingredients and fried	7.25
Dried seeds	Seeds of ripe fruit	The seeds are dried in sun to bring down the moisture content and preserved for future use. Fried and eaten as snack or cooked as curry	89.50

other stakeholders. As stated earlier, 61 respondents were following at least one or more such practices. Table 6 indicates that chips and pickle making were the most preferred value addition practices. Results highlight that the tribal communities prefer less complex value addition practices, which are less spicy and less oily as they are more compatible with their food habits.

Discussion

The study suggests that the average wastage of jackfruit was quite high in all the districts of Garo Hills because only 30.5% of the respondents engaged in value addition practices^{10,15,16}, which were limited to chips and pickle making. The average wastage percentage envisaged that more than half of the jackfruit production in Garo Hills got wasted, amounting to Rs. 15,13,098.65 (\$20,280.06). The respondents could not be able to market a very negligible amount of jackfruit (3970 kg)^{15,17} due to communication bottlenecks and poor marketing infrastructure in Garo Hills¹⁸. Lack of receiving training on the value addition of jackfruit was also another important reason for less value addition and a high degree of wastage¹⁹.

The average educational status was also on the relatively lower side, which might also have some bearing in the adoption of value addition practices of jackfruit. The average annual income of the respondents was also relatively lower, as the majority of the farmers were dependent on primary sectors (agri and agri-allied) as the sources of livelihood²⁰. But, the production potential of jackfruit is quite high, and the farmers had more than twenty years of farming experience.

The SGH and SWGH districts, in particular, have a high potential for jackfruit cultivation, as results show. The average age of plants in the SGH district was also relatively lower^{15,21}, but oldest^{10,22} in the SWGH district. Most interestingly, the average yield per tree was highest in the NGH district, whereas the number of plants was lowest. But, the average wastage of jackfruit was almost double in the SGH district than those of other districts in Garo Hills though production was also more than double in the SGH district. Thus, the SGH, SWGH, and NGH districts may be put under strategic development to intensify the jackfruit production in Garo Hills²³.

But, it may not change the scenario of jackfruit-oriented economy in the region until a meticulous

value addition strategy is adopted for Garo Hills²⁴. Identification, documentation of ethnic value addition practices, and their utilisation studies provide clear indication that less complex and less oily, less spicy foods were the preferred practices due to the compatibility of their food habits. But, it might not have good market demand outside the region and rest of the country, which reduced the marketability of such value-added products^{25,26}. Thus, standardisation of these value addition practices through laboratory research is needed to benefit to the local demand and outside market as well.

Conclusion

The value addition of jackfruit may contribute a significant change in the livelihood system of the tribal communities in Garo Hills. The majority of the farmers in Garo Hills follow indigenous methods due to a lack of formal training in the value addition of jackfruit. The standardised value addition practices of jackfruit developed elsewhere might have also limitations in terms of location specificity, cultural compatibility, economic viability in the local socio-economic conditions, and above all food habits. The study successfully identified and documented an inventory of the indigenous value addition practices of jackfruit by the ethnic tribal communities in Garo Hills, which are not scientifically validated and standardised yet. Thus, these indigenous value addition practices need to be scientifically validated, and standardised technologies should be developed by different research institutions in the region like ICAR Research Complex for NEH Region, central and state universities, and Krishi Vigyan Kendras (KVKs). A sustainable livelihood system for the ethnic tribal communities of Garo Hills could be developed through the adoption of standardised indigenous value addition practices, supplemented by meticulous and effective training and marketing strategies by the different extension agencies in the region like state departments of agriculture, horticulture, and food processing, KVKs and different NGOs working in the region. It can also contribute to the economic development of the region by minimising the huge wastages of jackfruit and marketing the value-added products.

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Conflict of Interest

We, the authors declare that we have no known competing financial interests or personal relationships that could appear to influence the work reported in the paper.

Authors' Contributions

TJTS & BL: Conceptualisation, design, supervision, survey, writing original draft; CPS & STP: Formal analysis, software, review & editing

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