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THE DEPENDENCE OF TRIBAL LIVELIHOODS ON FOREST FRUITS IN RURAL JHARKHAND, INDIA

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ABSTRACT

This paper explores the diversity, extraction, consumption and livelihood contribution of forest fruits among tribes in Bundu block of Ranchi district, Jharkhand. A multi-stage random sampling technique was employed to draw a sample of 164 households from 9 selected villages for field surveys. Data were collected through a structured interview, non-participant observation, key informant interview, focus group discussion, and market assessment. Simple descriptive statistics viz., frequency (f), percentage (%), mean (x), and range were applied to analyze the data. Results of the study revealed that 31 forest fruits harvested from 26 trees and 5 shrubs belonging to 28 genera and 21 families and consumed as ripe fruit (24) followed by pickle (9), vegetable (4), oilseed (3), roasted/boiled seed (3), drink (2), dehydrated unripe slices (1), fruit aril (1), fruit leather (1), kernel (1), sauce (1), soar product (1) and vinegar (1). Total extraction of forest fruits was 19312.60 kg/year, of which 70.37% was sold for cash income and the rest 29.63% were consumed for subsistence. Sale of forest fruits accrued an annual income of ₹ 246685.00 which contributed 3.90% of the total household annual income. Forest fruits constitute a key source of food, nutrition, subsistence, cash income and safety nets. Overharvesting of forest fruits to mitigate livelihood stress is likely to deplete their availability which would greatly affect the tribal welfare and food security. To promote forest fruit's conservation, forest management should be harmonized with tribal development, poverty alleviation, food security, and livelihood sustainability strategies and thus, some additional policies will be required.

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1 Introduction

Forest fruits are an indispensable source of diet, food, nutrition, health care, and livelihood for poor people in rural areas throughout the world (Srivastava, 2013; Biswas et al., 2018; Hazarika & Marak, 2019). These fruits serve as a crucial constituent of the human diet supplying the minerals, vitamins, hormone precursors, protein fibers, polyphenols, antioxidants, and energy (Seal et al., 2014; Shah et al., 2019). Consumption of these forest fruits reduces the risk of several ailments like diabetes, cancer, heart disease, neurodegenerative disorders, *etc.* (Gireesha & Raju, 2013; Sarmah et al., 2013; Zhai et al., 2020). Uses of forest fruits as a diet supplement or as a coping mechanism in food shortage times provide an important safety net for the rural people (Mahapatra & Panda, 2012; Chakraborty & Chaturvedi, 2014). In developing countries, forest fruits contribute up to 80% of the population's dietary, health and nutritional needs (Majumdar & Datta, 2009; Muzaffer et al., 2016). Forest fruits offer diet diversity and have become a valuable livelihood strategy and alternative option for rural poor during food insecurity and nutritional stress (Khatoun et al., 2012; Brahma et al., 2013). Some forest fruits are reported to be more nutritious than conventionally cultivar fruits (Hegazy et al., 2019; Shan et al., 2019). Besides food and nutrition, the utilization of forest fruits also satisfies the socio-economic, cultural, religious, spiritual, and ethnobotanical aspirations of the forest dwellers and primitive communities (Neudeck et al., 2012; Lyngdoh et al., 2016). The forest fruits have gained global attention due to a significant role in ensuring food and livelihood security in underdeveloped and developing countries of the world (Seyoum et al., 2015; Abdullah et al., 2020).

The forests of Bundu block of Ranchi district in Jharkhand, India is bestowed with a considerable diversity of forest fruits constituting an important source of food, nutrition, and livelihoods of tribal communities (Islam & Quli, 2016). These communities have distinct food habits and dietary traditions and hence, they extract the forest fruits in sizeable quantities since the cultivar fruits are less familiar and not accessible to them. Further, acute poverty and low socio-economic condition also escalate their dependency substantially on forest fruits for household subsistence consumption and cash income. The custom, tradition, spirit, values, taboos, rituals, social and ethical norms possessed by local tribal people have a deep-rooted influence on the cultural inheritance and sustainable use and conservation of forest fruits (Slathia et al., 2017). Traditional knowledge is an indispensable part of the tribal culture and the essence of their social capital co-evolved over the ages to adjust with the needs and interests of the surrounding environments and transmitted from generations (Sinha & Lakra 2005; Mairh et al., 2010). The traditional practices prevalent and practiced by the tribes need to be preserved and practiced to ensure the judicious use and management of precious

diminishing natural resources (Singh et al., 2012). The exploration, documentation, preservation, and popularization of forest fruits are very important as cheap sources of food for human consumption and livelihood sustenance (Biswas et al., 2018; Hazarika & Marak, 2019). The values of these forest fruits persuade to employ a judicious management plan to conserve these resources for sustainable and continued supply for the future generation (Deb et al., 2013). Unfortunately, the traditional wisdom of tribal communities about the local forest fruits is diminishing because the primitive cultures are getting eroded (Mahapatra & Panda, 2012). Information on forest fruits has the potential to address the food insecurity and can act as a low cost option in development strategies for food security of the rural poor (Dangwal et al., 2014). Over the past few years, the widespread reliance of tribal people on forest fruits has spawned a growing scientific interest among researchers, policymakers, and development practitioners in developing countries (Shivprasad et al., 2016). Further, such scientific studies on forests-people interactions are essential tools in devising alternative strategies for food and livelihood security, poverty reduction and forest conservation (Gangte et al., 2013). Notwithstanding, with a few noteworthy exceptions, there is little empirical research on the traditional wisdom and people's dependence on forest fruits for food and livelihood security. Considering these facts, this study was undertaken to document essential information on forest fruits, their diversity, seasonality, distribution, mode of use, quantity extracted, subsistence consumption, cash income, and employment.

2 Materials and Methods

2.1 Study area, population statistics and climate

The study was conducted in Bundu block of Ranchi district in Jharkhand, India lying between 23°11' - 23°18' North latitude and 85°35' - 85°58' East longitude at an altitude of 337 m above MSL. It extends over a geographical area of 25097 ha and the major land covers are un-irrigated cultivable land (69.25%), forest (17.44%), irrigated cultivable land (8.41%), culturable wasteland (3.59%), unculturable wasteland (1.29%) and non-agricultural use (0.02%). The major forest type in the block is northern tropical dry deciduous forests (5B/C2) (Champion & Seth, 1968) which falls under Bundu Range of Khunti Forest Division. Total population is 62509 people (31624 males and 30885 females) inhabiting 11495 households of 88 villages (Anonymous, 2009). The block has 23572 literate people (16084 males and 7488 females) which accounts for 44.02% of the total population. The major livelihood activities include agriculture, NTFPs collection, and livestock production. The climate is dominantly tropical having three distinct seasons, summer, monsoon and winter. The block has an erratic rainfall of 1413.60 mm; the mean minimum temperature of 24°C and a mean maximum temperature of 37.2°C (Sahu, 2008).

2.2. Sampling, data collection and analysis

Before the survey, all the secondary data relevant to the study were gathered from all possible sources. Based on the baseline information multi-stage random sampling technique (Ray & Mondol, 2004) was adopted to select a representative sample of 164 households from the 9 selected villages in the block for field survey. Field data collection in the sample households was carried out using personal interviews, non-participant observations, semi-structure interviews, focus group discussion and periodical market assessments (Mukherjee, 1993). The survey was carried out using a structured interview schedule aimed at capturing both qualitative and quantitative information. Non-participant observations were structured to interact and record the respondent's behaviors for empirical aims in the natural situation. Using the checklist questions, the valuable key informants were interviewed for information collection on various relevant issues. The focus group discussions were undertaken involving eight to twelve members where the lead author served as a facilitator while the insiders fully participated in the dialogue. Several major relevant issues were raised for discussion which helped to cross-check and validate the data generated. Periodical market inventories were conducted in nearby local markets to record the market prices of different forest fruits. The information documented were common/vernacular names of forest fruits, seasonality, mode of consumption, quantity collected, subsistence consumption, quantity marketed, sale rate, subsistence income, cash income, total income, employment generation and gross annual income consisted of various livelihood sources. The data were analyzed by simple descriptive statistics

viz., frequency (f), percentage (%), mean ($\bar{x}$) and range (Snedecor & Cochran, 1967), and the results were displayed through charts and tables.

3 Results and Discussion

3.1 Diversity and consumption mode of forest fruits

The study documented 31 forest fruits belonging to 28 genera and 21 families which were commonly collected and consumed by the tribal communities to meet their daily food and nutritional needs (Table 1). The family Moraceae had the highest representation with five forest fruits followed by Anacardiaceae (4), Rubiaceae (2), Rutaceae (2), Sapindaceae (2), Alangiaceae (1), Anacardiaceae (1), Anonaceae (1), Apocynaceae (1), Arecaceae (1), Caesalpiniaceae (1), Dilleniaceae (1), Dipterocarpaceae (1), Ebenaceae (1), Euphorbiaceae (1), Lecythidaceae (1), Meliaceae (1), Mimosaceae (1), Myrtaceae (1), Rhamnaceae (1) and Rosaceae (1) (Figure 1). Fruits were mainly consumed as ripe fruit (24) with few as a pickle (9), vegetable (4), oilseed (3), roasted/boiled seed (3), drink (2), dehydrated unripe slices (1), fruit aril (1), fruit leather (1), kernel (1), sauce (1), soar product (1) and vinegar (1) by the tribal people (Figure 2). The fruits were mostly (26) collected from trees while the rest (5) were produced by shrubs (Figure 3). Although, the forest fruits were harvested around the year but more than half the fruits (61.29%) are available during the monsoon season only, *i.e.* between June and October (Table 1).

The diversity of forest fruits consumed reflected that the forest of the local landscape is enshrined with rich biological diversity. Forest

Figure 1 Proportion of forest fruit species by family (N=164)

Table 1: Diversity of forest fruits extracted by the tribal people (N=164)

Species	Family	Local name	English/ Common name	Seasonality	Mode of consumption
<i>Aegle marmelos</i> L.	Rutaceae	<i>Loagassi</i>	Wood apple/ <i>Bel</i>	May-June	Ripe fruit- edible, drink
<i>Alangium salvifolium</i> Linn.	Alangiaceae	<i>Dhela</i>	Ankol/ <i>Akola</i>	June-July	Ripe pulp- edible
<i>Annona squamosa</i> L.	Anonaceae	<i>Madar</i>	Custard apple/ <i>Sharifa</i>	July-September	Ripe fruit- edible
<i>Artocarpus heterophyllus</i> Lamk.	Moraceae	<i>Kathar</i>	Jackfruit/ <i>Kathal</i>	April-July	Ripe fruit- edible, unripe fruit- pickle, vegetable, roasted/ boiled seed- edible
<i>Artocarpus lakoocha</i> Roxb.	Moraceae	<i>Dahu</i>	Monkey jack/ <i>Barhar</i>	March-July	Ripe fruit- edible, unripe fruit- vegetable
<i>Azadirachta indica</i> A. Juss.	Meliaceae	<i>Neem</i>	Indian lilac/ <i>Neem</i>	June- July	Ripe fruit pulp- edible
<i>Buchanania angustifolia</i> Roxb.	Anacardiaceae	<i>Pithwar</i>	Piyala/ <i>Char-pithwar</i>	April-May	Ripe fruit pulp- edible
<i>Buchanania lanzan</i> Spreng.	Anacardiaceae	<i>Tarob</i>	Chironji/ <i>Piar</i>	April-May	Ripe fruit- pulp edible, kernel- confectionary
<i>Careya arborea</i> Roxb.	Lecythidaceae	<i>Kumbhi</i>	Slow match tree/ <i>Kumbhi</i>	June- July	Ripe fruit- edible
<i>Carissa carandus</i> Linn.	Apocynaceae	<i>Kanwar</i>	Karonda	May-July	Ripe fruit- edible, unripe fruit- pickle
<i>Citrus limon</i> (L.) Berm. F.	Rutaceae	<i>Kagzi nimbu</i>	Lemon/ <i>Lemu</i>	April-June	Ripe fruit- pickle, drink
<i>Dillenia indica</i> Linn.	Dilleniaceae	<i>Korkot</i>	Elephant apple/ <i>Rai</i>	December-February	Ripe fruit- edible, unripe fruit- pickle
<i>Diospyros melanoxylon</i> Roxb.	Ebenaceae	<i>Tiril</i>	Tendu/ <i>Kend</i>	April-May	Ripe fruit- edible
<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	<i>Meral</i>	Aonla/ <i>Amla</i>	October-April	Ripe fruit- edible, unripe fruit- pickle
<i>Ficus glomerata</i> Roxb.	Moraceae	<i>Loa</i>	Indian fig tree/ <i>Gular</i>	Feb-April	Ripe fruit- edible, unripe fruit- vegetable
<i>Ficus infectoria</i> Roxb.	Moraceae	<i>Pakar</i>	Pilkan/ <i>Dumar</i>	May-June	Ripe fruit- edible, unripe fruit- vegetable
<i>Gardenia latifolia</i> Aiton.	Rubiaceae	<i>Papra</i>	Indian boxwood/ <i>Paphar</i>	December-January	Ripe fruit- edible
<i>Madhuca latifolia</i> Macb.	Sapindaceae	<i>Madhucam</i>	Indian butter tree/ <i>Mahua</i>	June-July	Seed- edible oil
<i>Mangifera indica</i> Linn.	Anacardiaceae	<i>Uli</i>	Mango/ <i>Aam</i>	May-July	Ripe fruit- edible, unripe fruit- pickle, dehydrated slices of green fruit (<i>Amsi</i>)- sour preparation, fruit leather (<i>Amthi</i>)- an important trade article
<i>Morus alba</i> Linn.	Moraceae	<i>Toont</i>	Mulberry/ <i>Siah Tut</i>	May-June	Ripe fruit- edible
<i>Phoenix acaulis</i> Roxb. ex Buch.	Arecaceae	<i>Kita</i>	Date palm/ <i>Khajur</i>	May-June	Ripe fruit- edible
<i>Pithecolobium dulce</i> Benth.	Fabaceae	<i>Singri</i>	Jangal jalebi	April-June	Fruit aril- Edible
<i>Prunus persica</i> Batsch.	Rosaceae	<i>Satalu</i>	Peach	May-June	Ripe fruit- edible
<i>Randia uliginosa</i> DC.	Rubiaceae	<i>Piurar</i>	Penaura/ <i>Piurar</i>	December-February	Ripe fruit- edible
<i>Schleichera oleosa</i> (Lour.) Oken	Sapindaceae	<i>Kusum</i>	Ceylon oak/ <i>Kusum</i>	July-August	Ripe fruit- edible, seed- edible oil
<i>Semecarpus anacardium</i> Linn.	Anacardiaceae	<i>Soso</i>	Marking nut/ <i>Bhelwa</i>	December-March	Seed- edible
<i>Shorea robusta</i> C. F. Gaertn.	Dipterocarpaceae	<i>Sarjom</i>	Sal/ <i>Sakhua</i>	June- August	Seed- edible oil
<i>Spondias mangifera</i> Willd.	Anacardiaceae	<i>Ambru</i>	Golden apple/ <i>Amra</i>	January-February	Unripe fruit- pickle
<i>Syzigium cumini</i> (Linn.) Skeels	Myrtaceae	<i>Kund</i>	Blackberry/ <i>Jamun</i>	June-August	Ripe fruit- edible, ripe fruit pulp- vinegar
<i>Tamarindus indica</i> Linn.	Caesalpinaceae	<i>Jojo</i>	Tamarind/ <i>Imli</i>	December-April	Fruit pulp- sauce, fruit pulp- pickle, soar preparation, roasted seed- edible
<i>Zizyphus mauritiana</i> Lamk.	Rhamnaceae	<i>Bakra/ Koir</i>	Indian jujube/ <i>Ber</i>	January-March	Ripe fruit- edible, pickle

Figure 2 Proportion of forest fruits by consumption mode (N=164)

Figure 3 Proportion of forest fruits by life forms (N= 164)

fruits constitute the major part of the food basket of the tribal communities. Food and nutritional security is a severe predicament among most of the tribal families (Islam et al., 2015); hence, people harvest and consume a large variety of forest fruits frequently. Forest fruits contribute to food and nutritional security in two ways; first, direct subsistence consumption next to grains and second, sale of fruits to purchase grains in exigency. Due to acute poverty, the poor tribal people are unable to secure a diet rich in carbohydrates, vitamins, protein, sugar, fats, minerals, *etc.*, thus, the forest fruits are the chief sources meeting their daily diet necessities. Marginal returns from crop and livestock products and low employment opportunities have

enforced many tribal people to sell the forest fruits in the local weekly markets. As the marketing of edible fruits is unregulated, urban people are unfamiliar to the forest fruits and the middlemen are operational in the trade, the tribal vendors get a very low price which is not remunerative to their labour and time vested. The cash income earned by the sale of the fruits contributes substantially to the household annual income which is primarily used to purchase grains; hence, the fruits are the principal safety net and key coping approach to combat food shortages for the tribal poor. The earlier studies (Seyoum et al., 2015; Islam & Quli, 2016; Lyngdoh et al., 2016; Muzaffer et al., 2016; Slathia et al., 2017; Biswas et al., 2018; Hazarika & Marak, 2019; Shah

et al., 2019; Abdullah et al., 2020) across the world which documented the diversity and food potential of forest fruits confirm that the forest fruits play a significant role in food security, subsistence, cash benefits and safety nets in the tribal communities.

3.2 Livelihood security through forest fruits

The total extraction of forest fruits from the forest in the surveyed population was 19312.60 kg/year @ 4.40 kg per capita/year. Of the

total extraction, 13590.00 kg (70.37%) of the fruits were sold for earnings, and the rest 5722.60 kg (29.63%) fruits were consumed for subsistence by the tribal people (Table 2). The forest fruits fetched a total income of ₹ 246685/year @ ₹1504.18/household/year with an annual employment opportunity of 500.02 man-days @ 3.05 man-days/household/year. The total income included a major share by cash income of ₹178565/year (72.39%) while the subsistence income contributed a sum of ₹ 68120/year (27.61%). *Mangifera indica* L. fetched the maximum cash income of ₹ 31000.00/year while

Table 2 Household income and employment composition by different forest fruits (N=164)

Forest fruit	Collection (kg/year)	Subsistence consumption (kg/year)	Sale (kg/year)	Rate (₹/kg)	Subsistence income (₹/year)	Cash income (₹/year)	Total income (₹/year)	Employment (man-days/year)
Wood apple/ <i>Bel</i>	1147 ^Δ	150 ^Δ	997 ^Δ	3/ Δ	450	2991	3441	22.94
Ankol/ <i>Akola</i>	156	156	0.00	5	780	0.00	780	15.60
Custard apple/ <i>Sharifa</i>	272	96	176	20	1920	3520	5440	13.60
Jackfruit/ <i>Kathal</i>	1065	540	525	5	2700	2625	5325	21.30
Monkey jack/ <i>Barhar</i>	348	139	209	5	695	1045	1740	17.40
Indian lilac/ <i>Neem</i>	41	41	0.00	0.00	0.00	0.00	0.00	4.10
Piyala/ <i>Char-pithwar</i>	73	61	12	5	305	60.00	365	7.30
Chironji/ <i>Piar</i>	168	0.00	168	150	0.00	25200	25200	8.40
Slow match tree/ <i>Kumbhi</i>	7.50	7.50	0.00	0.00	0.00	0.00	0.00	1.50
Karonda	326	56	270	10	560	2700	3260	10.52
Lemon/ <i>Lemu</i>	30	10	20	10	100	200	300	4.50
Elephant apple/ <i>Rai</i>	20	20	0.00	0.00	0.00	0.00	0.00	2.0
Tendu/ <i>Kend</i>	420	70	350	10	700	3500	4200	8.40
Aonla/ <i>Amla</i>	250	100	150	10	1000	1500	2500	10.00
Indian fig tree/ <i>Gular</i>	100	40	60	10	400	600	1000	10.00
Pilkhan/ <i>Dumar</i>	80	35	45	10	350	450	800	8.0
Indian boxwood/ <i>Paphar</i>	50	20	30	10	200	300	500	5.0
Indian butter tree/ <i>Mahua</i>	1602	150	1452	12	1800	17424	19224	32.04
Mango/ <i>Aam</i>	2860	1310	1550	20	26200	31000	57200	57.20
Mulberry/ <i>Siah Tut</i>	485	165	320	10	1650	3200	4850	9.70
Date palm/ <i>Khajur</i>	550	150	400	10	1500	4000	5500	11.00
Jangal jalebi	20	20	0.00	0.00	0.00	0.00	0.00	2.50
Peach	220	40	180	10	400	1800	2200	8.80
Penaura/ <i>Piurar</i>	50	15	35	10	150	350	500	2.50
Ceylon oak/ <i>Kusum</i>	780	195	585	10	1950	5850	7800	15.60
Marking nut/ <i>Bhelwa</i>	990	350	640	15	5250	9600	14850	19.80
Sal/ <i>Sakhua</i>	450	0.00	450	5	0.00	2250	2250	18.00
Golden apple/ <i>Amra</i>	400	150	250	8	1200	2000	3200	10.0
Blackberry/ <i>Jamun</i>	2016	336	1680	10	3360	16800	20160	40.32
Tamarind/ <i>Imli</i>	1550	250	1300	12	3000	15600	18600	31.00
Indian jujube/ <i>Ber</i>	3550	1150	2400	10	11500	24000	35500	71.00
Total	19312.60	5722.60	13590		68120	178565	246685	500.02
Average	117.76	34.89	82.87		415.37	1088.81	1504.18	3.05

Note: Δ = pieces; Average weight of wood apple = 0.334 kg

Buchanania angustifolia Roxb. accrued lowest income of ₹ 60.00/year in the tribal households.

Forest fruits are boon to the tribal people as it plays a significant role in the traditional food habits, nutrition, and health care and consumed in varied forms as ripe/unripe fruit, pickle, vegetable, oilseed, roasted/boiled seed, drink, dehydrated unripe slices, fruit aril, fruit leather, kernel, sauce, soar product, vinegar, confectionery, and other edible items. Forest fruits are one of the most economically valuable products of northern tropical dry deciduous forests of the block. The most commonly known fruits collected and traded in considerable quantity were *Mangifera indica* L., *Buchanania lanzan* Spreng., *Zizyphus mauritiana* Lamk., *Madhuca latifolia* Macb., *Syzygium cumini* (Linn.) Skeels, *Tamarindus indica* Linn., *Semecarpus anacardium* Linn., *Schleichera oleosa* (Lour.) Oken, *Phoenix acaulis* Roxb. ex Buch., *Annona squamosa* L., *Diospyros melanoxylon* Roxb. and *Morus alba* Linn. Next profitable forest fruits to tribal people include *Aegle marmelos* L., *Carissa carandus* Linn., *Artocarpus heterophyllus* Lamk., *Shorea robusta* C. F. Gaertn., *Spondias mangifera* Willd., *Prunus persica* Batsch., *Emblia officinalis* Gaertn., *Artocarpus lakoocha* Roxb., *Ficus glomerata* Roxb., *Ficus infectoria* Roxb., *Randia uliginosa* DC., *Gardenia latifolia* Aiton., *Citrus limon* (L.) Berm. F., *Buchanania angustifolia* Roxb., *Alangium salvifolium* Linn., *Azadirachta indica* A. Juss., *Careya arborea* Roxb., *Dillenia indica* Linn. and *Pithecolobium dulce* Benth. which were collected and traded comparatively in low quantity. The forest fruits are mainly collected for livelihood earning and only a little fraction is retained for self-consumption. The forest fruits were sold by the primary collectors to the consumers or middlemen at the village level or the local weekly market (Figure 5). The fruits provide different products that, through their subsistence and cash income, are of importance for household

livelihoods. The household involvement in collection and marketing differ with the types of fruits, availability, household consumption, market price, and socioeconomic conditions of the tribal people.

The average total annual income of the sample households was ₹ 27894.20 which was mostly constituted by crop (36.24%), nonfarm (29.88%), forest (21.11%), livestock (8.86%), and forest fruits (3.90%) (Figure 4). Crop cultivation is the main livelihood source and rain-fed agriculture using dryland varieties of paddy form mainland use. Wage labour, business, shopkeeping, service, remittances, etc. are the major nonfarm sources of income. The tribal households rely on a wide range of economic activities mainly related to forest resource extraction. Forest income contributes substantially to the total income, which was second to crop production, even without the inclusion of income from forest fruits. Sale and consumption of livestock and livestock products are also an important source of income. Concerning income from forest fruits, with an average share of 3.90% income, it was the fifth contributor to the total income streams in the tribal households. The forest fruits serve as a viable source for both subsistence and cash income because the substitute options are limited or even absent, land for agriculture is very low and the profits to crop or livestock are marginal. Nonetheless, the cash income earned from forest fruits is a bit small; involvement in the trade is an indispensable source of self-esteem, pride, and independence among the tribal people. The studies (Khatoon et al., 2012; Mahapatra & Panda, 2012; Brahma et al., 2013; Srivastava, 2013; Chakraborty & Chaturvedi, 2014; Seal et al., 2014; Seyoum et al., 2015; Lyngdoh et al., 2016; Shivprasad et al., 2016; Biswas et al., 2018; Hazarika & Marak, 2019; Hegazy et al., 2019; Shah et al., 2019) on forest fruits advocate that these forest resources have a significant contribution to the household livelihood security in tribal people.

Figure 4 Annual household income by livelihood sources (N= 164)

Figure 5 Forest fruits sustaining livelihood security of tribes

Conclusion

Collection of forest fruits is an important source of food, subsistence, cash income and a safety net for tribal people in Jharkhand. Poverty among the tribes is so overwhelming that huge bulk of the forest fruits is sold for cash income while a little fraction is retained for subsistence consumption. Although, the

economic value of forest fruits is not analogous to the labours spent in the endeavor but the cash income accrued is significant to sustain the household livelihoods. Current unsustainable extraction, increased market pressures on fruit resources, loss of forests due to conversion to agriculture and rapid population growth are likely to decline the availability of forest fruits in near future. Further, the unbalanced interaction between the people and

the forest ecosystem is liable to worsen the success of conservation and sustainable management of edible fruits. Hence, sustainable forest management and conservation through forest access regulation is crucial to keep pace with the current development and future challenges. Awareness creation and capacity building of tribes in sustainable forest resources management, domestication, production, harvesting, handling, and value-addition of economically and culturally important fruits and entrepreneurship in micro-enterprises of forest fruit products are the future interventions which can compensate the conservations efforts and promote livelihood diversification for the poorest groups. The present findings on forest fruits-household income link suggest that the forest edible fruits should be given a due focus in development and policy implications to harmonize the livelihood improvement and poverty alleviation besides forest conservation in the tribal Jharkhand.

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Conflict of interest

No conflict of interests among the authors.

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