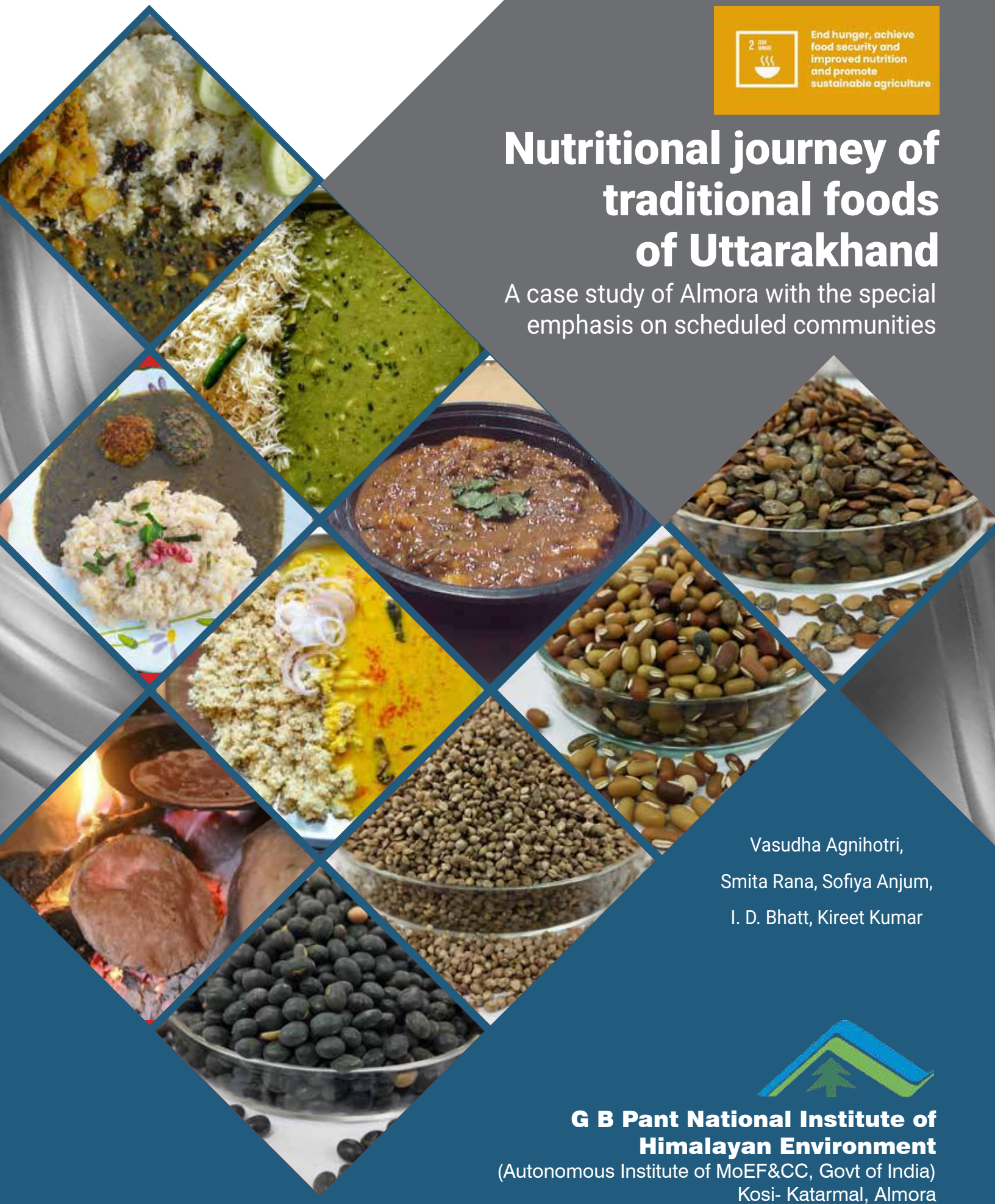
End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Nutritional journey of traditional foods of Uttarakhand

A case study of Almora with the special emphasis on scheduled communities



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This technical report contains information on nutritional composition of traditional foods, consumed by residents of Uttarakhand, mainly targeting the marginalized communities. The food frequency questionnaire output generated through survey with marginalized communities resided in Almora district of Uttarakhand is also the part of this technical report. All the sources used for writing the methodologies are tried to be indicated. No part of this document is to be published, copied, or used otherwise without proper reference. This report is the output of the work carried out under the project funded by Department of Science and Technology- Natural Resource Database Management System (SC/ST scheme)

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Foreword

Food and nutritional security are a fundamental right of human being. Various national and international initiatives are ongoing to provide full security of food and nutrition to the people but in-spite of the fact there are over 35% of the total population who are suffering from hunger and their per day income is around $ 1.25/ day in India. While considering the children under age of five years, 74% are reported to be anemic and 43% are underweight. While considering the Global hunger index 2020, 14% of the total population of India is undernourished. This situation is prevalent all across this country and Uttarakhand is no exception, Therefore, there is an urgent need to address the problem of malnutrition and alternative food crops need to be identified. In this context, traditional crops, which was generally known as 'mota anaj' can fulfil the need of nutritional and food insecurity in the Himalayan region. These crops are traditionally been cultivated in the region but due to various reasons, their cultivation is decreasing in spite of the fact that they are rich in nutritional and nutraceutical properties. They are called as 'superfood' considering their rich nutritional content. The booklet entitled 'Nutritional journey of traditional foods of Uttarakhand' prepared by the institute is highlighting the nutritional content in these foods. The information presented in the booklet will help to promote recipes prepared by the traditional methods and their demand may encourage farmers for their cultivation. The booklet contains numerous photographs, and available data making it user friendly. This information will be useful for policy makers, food researchers, agriculturists, and research organizations, local administration and those who are interested in the traditional food crops of Uttarakhand. I congratulate team of authors for their hard work to bring out the nutritional quality of selected traditional foods of Uttarakhand.

Dr. R.S. Rawal

Director

Status of food security

The United Nations sustainable development goals include eradication of hunger with the aim to achieve food security and improve nutrition to every person on the earth.. To feed 10 billion persons up to 2050, we need to get the trade-offs right between sustainability, food security, food safety, and make better use of food already produced.

'Food security' exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (World Food Summit 1996).

The available food should be of good quality, safe, healthy, available in sufficient quantity, and acceptable to the people living in that area. The United Nation's Food and Agriculture Organization (FAO) had analysed that one in every nine people in the world is currently malnourished which is equivalent to 809.9 million people (Fischler et al.2015; FAO 2014; Jose, Gulati, and Khurana 2020). The figure is expected to rise to 2 billion people by 2050 if nothing is done (FAO, IFAD, UNICEF, WFP and WHO. 2019). Analysis of the distribution of the undernourished population across regions in the world shows that the majority of it (more than 500 million)lives in Asia. COVID-19 has had a further and profound impact on hunger and food security, triggered by disruptions in food supply chains, income losses, widening social inequities, an altered food environment and price hikes. During this time, achieving food security goes beyond the eradication of hunger. Nearly one in three people in the world (2.37 billion) were affected by moderate or severe food insecurity in 2020 (UN 2021). Similarly, malnutrition in India is a serious issue of concern from a national as well as global perspective. Out of 809.9 million undernourished people globally. 2016-18,

around 194.4 million people were in India in 2016-2018 (Jose, Gulati, and Khurana 2020). In India, agricultural growth has helped the country

to achieve self-dependence in the areas of many food grains. However due to the increase of population, the food demand is increasing. It was predicted that after the 2021 population survey, the total population of India will be around 1.39 billion, of which 445 million people might be poor (35% of the total population) with earnings of $1.25 a day. Half of the pregnant women are anaemic in India while in the case of children under the age of five years, 74% are reported to be anaemic and 43 percent underweight. Hence, ensuring household food and nutritional security is still a challenge for the country. According to the Global Hunger Index 2020 report, 14% of the total population of India is undernourished. The child stunting rate (37.4%) and 17.3% wasting rate among children under the age of 5 years are also major concerns (Grebmer et al. 2020).

Uttarakhand, one of the Himalayan states of India, is known for its scenic beauty and is also known as 'The Land of the Gods'. According to the 2011 census, this state with a population of more than one crore is the country's 20th most populous state. In the report, 'Healthy States Progressive India' published by the central government think tank, NITI Aayog, the state was relegated to 17th rank out of 21 states. This is a major concern as the state performed badly in most domains that include sex ratio, the infant mortality rate (IMR), and neonatal mortality rate (NMR), among others. According to the National Family Health Survey (NFHS) 4, conducted in 2015-16, Uttarakhand had witnessed 33.5% stunting, 26.6% underweight and 19.5% wasted cases among children below 5 years of age (International Institute of Population Sciences (IIPS, 2017). This shows the need of taking care of nutrition for all as child nutrition is dependent on the elder people of the family.

ROLE OF **TRADITIONAL FOODS** FOR COMBATING **FOOD SECURITY** ISSUE






Worldwide, human beings are moving away from the foods that are traditionally consumed by their generations. It is observed that they are replacing their healthy foods with diets that are excessive in sugar, sodium, fat, and calories, and this pattern is also percolating in the rural areas (Popkin, Adair, and Ng 2012). Traditional foods are believed to be associated with a balance diet and health, resilient agricultural systems, and cultural integrity during the current climate change scenario (Deaconu, Mercille, and Batal 2021). Such traditional foods, which are generally sourced from under-utilized crops, are now being neglected. Many such crops have the potential to contribute to food and nutritional security at local and regional levels along with environmental protection and by increasing the livelihood options for the locals (Padulosi, Thompson, and Rudebjer 2013).

The United Nations (UN) is also committed towards the zero hunger which can be understood by the fact that the UN had launched 17 Sustainable Developmental Goals (SDGs), out of which 12 SDGs are addressing the issue of sustainable supply of food for healthy lives, thereby signifying its role for better health, education, employment, and female empowerment. SDG 2 committed to end all types of hunger and malnourishment i.e. the body envisions a “zero hunger world” by 2030, particularly among children, and it underlines the importance of sustainable agriculture (Fischler et al. 2015; Yadava, Hossain, and Mohapatra 2018). This goal has a series of targets to support its three interrelated components, that is, ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture (Scholes, Ringler, and Von Braun 2015). Estimates of SDG Indicator 2.1.2, which monitors progress towards the target of ensuring access to food for all, reveal that a total of about 2 billion people in the world experience some level of food insecurity, including moderate. People who are moderately food insecure may not necessarily suffer from hunger, but they lack regular access to nutritious and sufficient food, putting them at greater risk of various forms of malnutrition and poor health. SDG 2.2 By 2030 targeted to achieve the end of all forms of malnutrition, by 2025 and internationally agreed targets are to reduce stunting and wasting in children under 5 years of age, and to address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

The traditionally used food items which are rich in nutrients might be helpful to achieve these targets. In the present study, an efforts had been made to understand the capacity of used food items for analyzing their efficiency for combating the problem of malnutrition in Uttarakhand region.

Uttarakhand is a hill state, situated in central Himalaya and can be differentiated from other areas based on topography, geographic features, flora and fauna, land use system, and socioeconomic conditions. The lifestyle of the people residing here also differs. The state comes under zone II among Agro-climatic zones in the Himalayan region. The state is further divided into different zones and Almora district comes under zone C among agroclimatic zones of Uttarakhand, where the farming is generally rainfed, the soil is red to dark and rainfall distribution is 1200-2500 mm/year. There are different types of traditional crops like cereals, millets, pulses, oilseeds; vegetables that are being cultivated in the region. Many of these crops are also identified as superfoods, which were earlier known as neglected and underutilized species (NUS). But the people are taking less interest in their cultivation.

Traditional food consumed by the local people, since long, plays a significant role in consumer's local identity, their behaviour, social, cultural, religious and economical domains which in the form of heritage passes on from generation to generation for its sustainable usages. Native peoples who live in remote areas mostly rely on traditional foods that are collected from the local surrounding environment. As Uttarakhand carries many cultural and ecological differences, it has been highly diversified in terms of traditional products. There are many recipes used as a substitute for items, which are meagrely produced in the region. The nutritional information of raw materials up to final recipes following different processing steps is not yet available.

There are many recipes which are used as an alternative of food items, but their production is meager in the region. These products need to be notified with geographical details to establish faith and to become brands in the market. In addition to the geographical indication in traditional art crafts and agricultural products, an increase is observed in the geographical indication of traditional foods in Uttarakhand. The new generation of these rural people is less interested to hold traditional knowledge because of some sort of inbreeding modern culture among them. It is only the elder people who have been nurturing the knowledge of applications of these crops and the spices used in the preparation of recipes from the respective crops. In the present study, traditional foods consumed by Scheduled communities, residing in the selected areas of Uttarakhand, are documented with their nutritional content. The selected targeted grains were horse gram, black soybean, rice bean, and barnyard millet and the average production of some of these crops in Almora district is shown in Box 1. The project aimed to promote the use of traditional cuisines not only for better health but also for the economic advancement of the large farming community in the state. These foods can also become a part of the food consumed in other regions of the country. It is expected that with the increased requirement, pressure on the production of these crops will be increased which will directly increase the income of scheduled communities along with other sections of the society over a large region.

Box 1: Average production in Almora district of Uttarakhand

Name of grains	Average production (Quintal/hec)
Horse gram	9.84
Black soybean	12.17
Barnyard millet	10.43

STUDY DESIGN AND FIELD OBSERVATIONS

Study was designed as shown in Figure 1

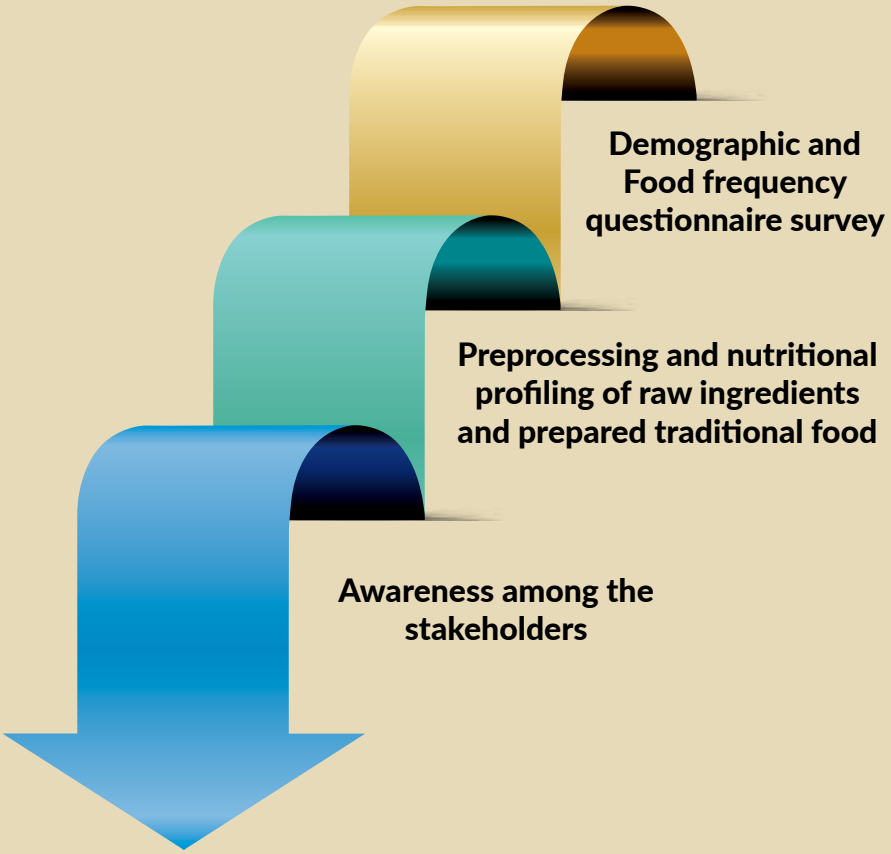


Figure 1: Steps followed during the project work

Demographic and food frequency questionnaire survey

Demographic survey

Before documenting the traditional way of food processing, the villages were identified in the nearby area of the institute, based on the scheduled community (SC) population. Population data were obtained from district level Sankhyiki patrika 2011. Almora district was selected for understanding the population structure of the rural population as well as scheduled community-based population (Figure 2 and 3). There are 11 blocks in the Almora district, out of which Hawalbag block was selected for the present study. The SC population was surveyed among the villages of Hawalbag block and based on that 5 villages namely Katarmal, Hawalbagh, Matela, Mahet Gaon, and Shyona was selected. As the project involves the nutritional analysis of freshly prepared traditional foods, so the selection of villages was also based on the distance between the laboratory and the villages. Preliminary meeting with the Gram Pradhan and Asha of the villages was conducted to identify the total number of families which fall under the category of Schedule community (Figure 4 and 5).

Demographic study of the scheduled community was gathered using collective methods such as self-observations during field visit, personal interview, and group discussion (Plate 1). For the personal interview, whole family was taken as a unit instead of single

individual because on many occasions the key informers were aided by his/her family members in providing information. Moreover, it forms like semigroup discussion where members of different age groups in different villages contribute to make the information more comprehensive. Interviews were conducted onsite with each household. For questionnaire, total of 77 households have been surveyed, out of which the total SC population per village was also documented as shown in Figure 6. From each household, one person had been selected for the questionnaire survey, which means a total of 77 respondents (representatives of 446 people) were interviewed for this survey.

During the field survey or while conducting interviews, socio-demographic characteristics of villagers including their age, education, marital status, occupation, family income, and total no. of family members were documented.

Through demographic data of the selected villages, it was observed that out of the total respondents, 48% were female while 52 % were males (Figure 7a). The population of females per thousand males was quite high or equal in three villages namely Panch gaon, Shyona, and Hawalbagh while in Matela and Katarmal village, it was found low (Figure 7b). The literate population was found highest in the age group between 15-

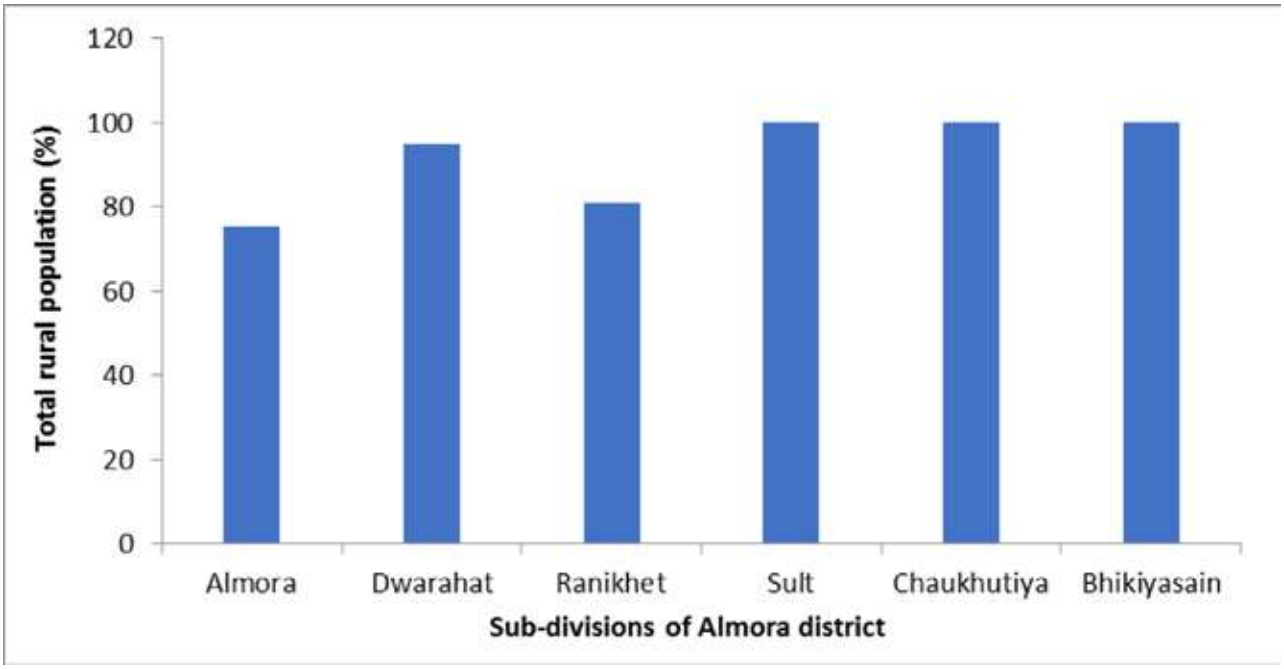


Figure 2: Rural Population (%) residing in different sub-divisions of Almora District

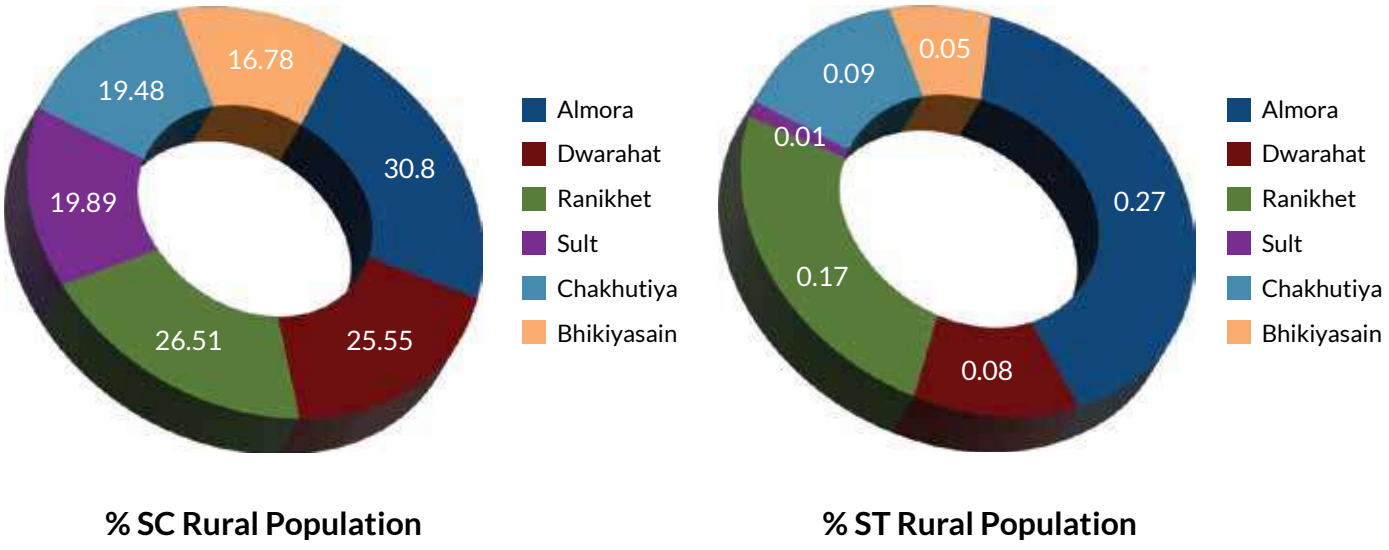


Figure 3: SC and ST rural population in Almora district

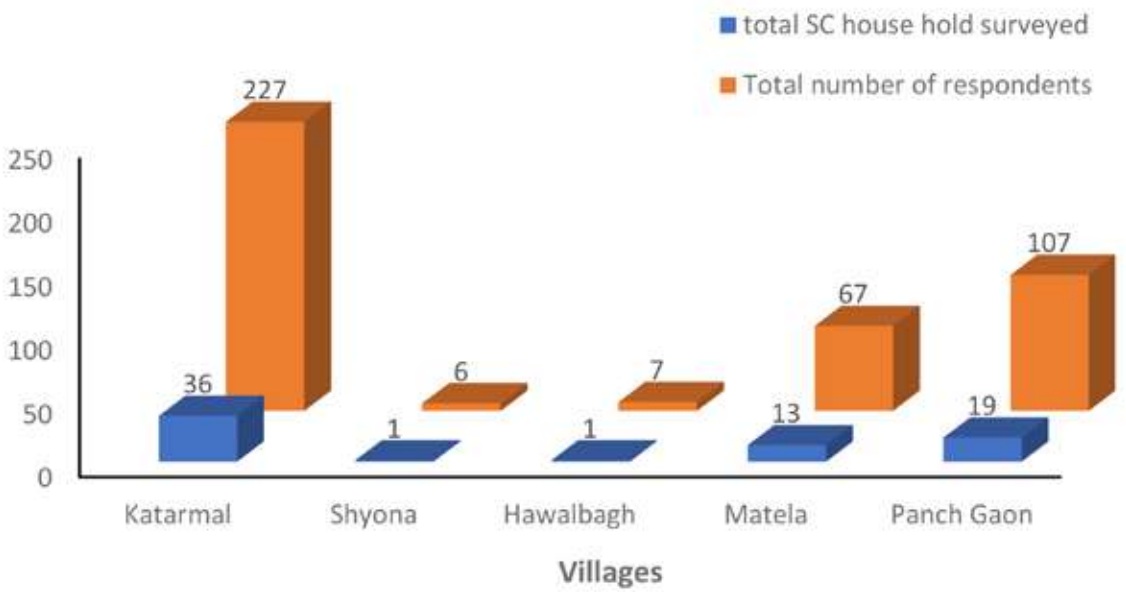


Figure 4: Number of households surveyed and number of respondents for questionnaire

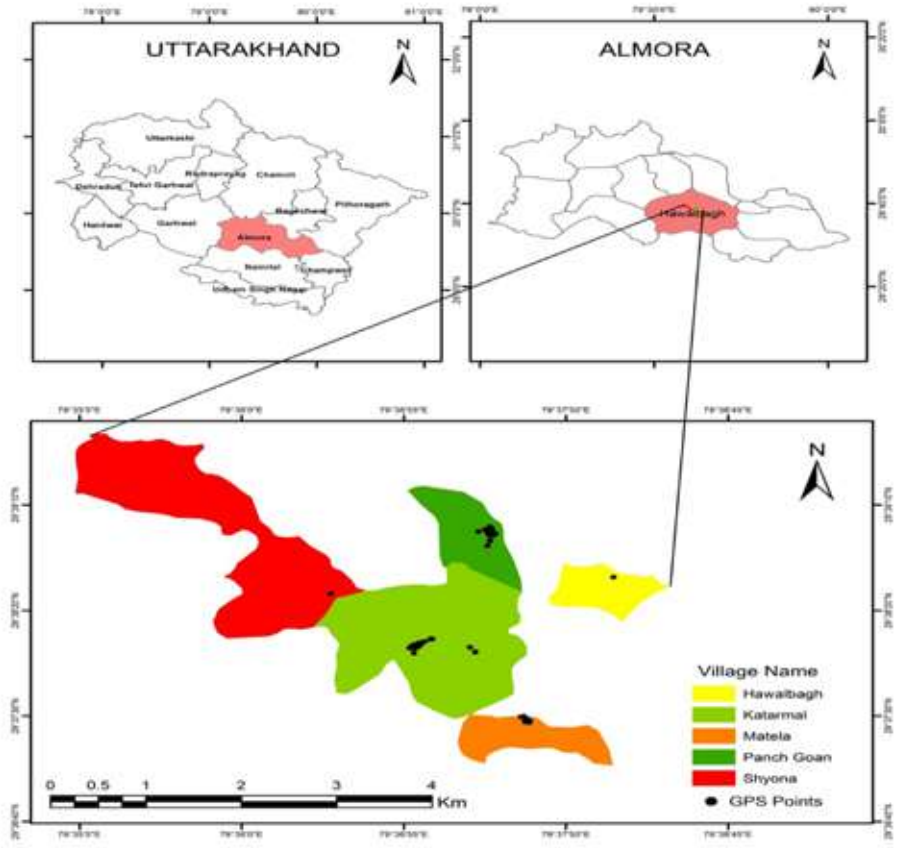


Figure 5: Study area showing the location points of respondents

30 years (100 per cent literate) in the community. In case of age group between 0-15 years the literacy percentage is 60.9 which are due to 38.34 per cent population of children below 7 years. Above 30 years of age, literate people percentage were found declining. The study depicts positive impact of right to education policy of Government of India on rural scheduled community. Increasing literacy rate in younger generation will also help to improve the overall dependency ratio.

Age dependency ratio, which is the measure of estimating the age structure of any society or community, was analysed for scheduled community (SC) of selected villages. This is generally analysed for understanding about the percentage of people capable of providing financial support to the dependants in case of any community or society. Age dependency ratio was calculated using the equation (1) (Borah et al., 2016; Han and Cheng, 2017).

$$\textit{Age dependency ratio} = \frac{(N_{0\text{-}15}+N_{>65})}{N_{15\text{-}64}}$$

Where N0-15 is number of SC people having age less than or equal to 15 years, N>65 are people having age more than 65 years and N15-64 is the main working people having age between above 15 years to 64 years. Villages under study have shown 49.66% age dependency ratio in the case of SC. The value is towards higher side but as 30% of the total population is between 0-15 years, the situation will be improved a lot in the coming years.

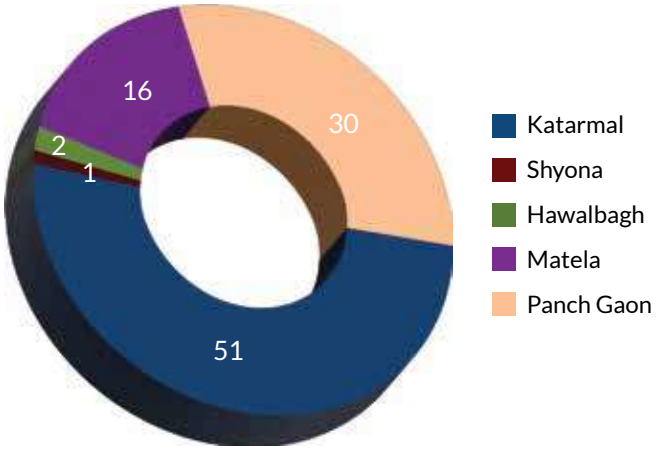
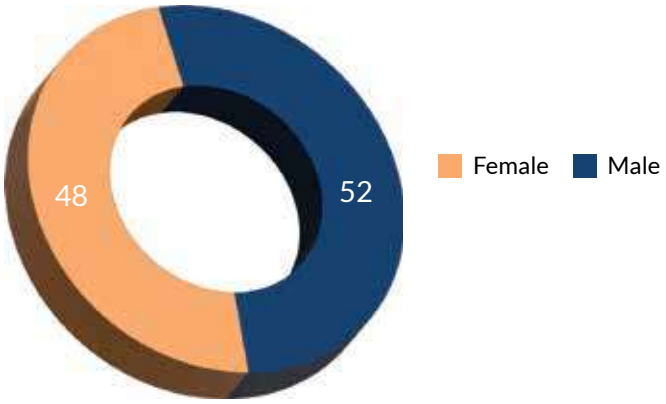


Figure 6: SC population percentage in selected villages

Based on household income data, collected through demographic survey, it was observed that the monthly income of most of the marginalized community people (58%) was between Rs. 5000- 20000/- (Figure 8). Through general demographic survey, it was observed that the people are moving away from agriculture as only 31 per cent SC people

Plate 1. Questionnaire survey in Villages

are engaged in this among all the selected villages (Figure 9). The main reason described were human-animal conflict (Patel & Pandya, 2014) and low rainfall which are discouraging them to go for agriculture except few crops which can be grown in less water but they grow such crops mainly for their own consumption. So, their agricultural practices are not giving them any direct economic benefits. The field survey reveals that most of the traditional cultivated crops grown by the villagers of selected study areas are generally drought resistant which can easily be grown in water scarce areas (although water required at some stages of their growth) and they are having very high nutritive values due to the presence of various types of bioactive constituents (Pati & Bhattacharjee, 2013; Singla & Kumar, 1985; Yadava & Vyas, 1994). Among the 77 surveyed households, 52 per cent respondents have the knowledge of medicinal properties of the crops although they were not aware of their nutritional content.



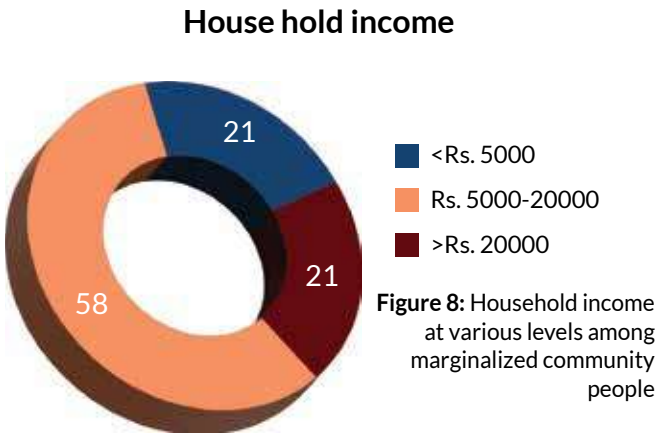


Figure 8: Household income at various levels among marginalized community people

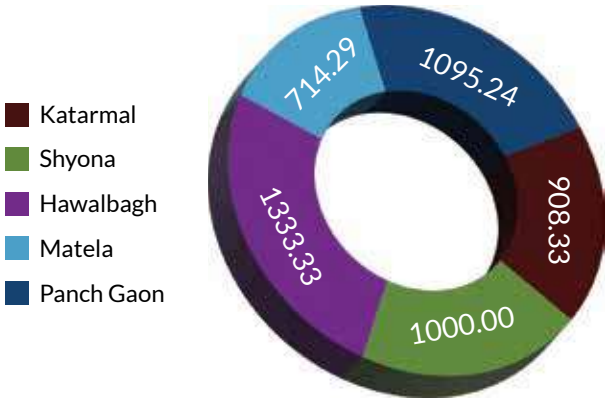


Figure 7 (a) Gender percentage among the SC population in the selected villages; (b) Female and male ratio among the marginalized community population in the selected villages (N=446)

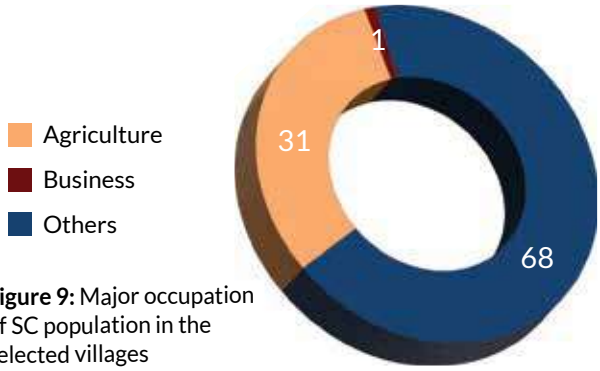


Figure 9: Major occupation of SC population in the selected villages

Assessment of dietary intake through FFQ

Interviewers collected information based on a wellstructured food frequency questionnaire (FFQ) (Fink, 1995), which was broadly divided into two categories i.e. first part was having personal information and the second part was having information related to their dietary aspects and on the production of crops. It was designed to gather detailed information about their dayto-day dietary patterns as well as their annual consumption of the most used traditional foods of the region. Respondents were also asked about the extent of production of crops used for the preparation of such food items. Their traditional food practices and attitudes/beliefs toward such traditional foods including information about the detailed procedure of preparation of these ethnic cuisines were also documented. The survey questionnaire included five closed ended questions with multiple response options and eight open-ended questions at the end of the survey. Through the Food frequency questionnaire (FFQ) survey, it was observed that marginalized community people (Scheduled caste) are mostly dependent on ration system for their diet and losing interest in agriculture. The study area is having the suitable climate for different drought resistant crops such as black soyabean (Glycine max; bhat), ricebean (Vigna umbellate; rais), horse gram (Macrotyloma uniflorum; gahat) and barnyard millet (Echinochlora frumentacea, jhangora), which are traditionally grown and consumed by the villager, but they cultivate these crops at very low level.

Crop Details

Horse gram (Macrotyloma uniflorum)
An underutilized warm season food legume, mainly grown as pulse crop in India, while as a forage crop in semi-arid regions of the world

Considered to be a good source of protein

Traditionally used to cure kidney stone.

Black soybean (Glycine max.)

An important source of protein.

Having high levels of antioxidants, which is useful for preventing the onset of various cancers.

source of healthy, unsaturated fat, which helps you lower your total cholesterol, specifically LDL cholesterol levels

Barnyard millet (Echinochlora frumentacea)

Nutritional and antinutritional properties helps in reducing malnutrition

Traditionally believed to possess good hypoglycemic activity

Rice bean (Vigna umbellate)

Helps to reduce the incidence of protein-energy malnutrition.

Used as a potential ingredient for development of protein rich products.

73 per cent SC villagers have told that they cultivate these crops for their own consumption. The data of the total production of selected crops (Kg/annum) in the surveyed areas by marginalized community people are shown in Figure 10.

The crops under study (horse gram, black soybean, barnyard millet) and specific Himalayan spices used in the cuisines prepared using these crops have great socio-economic significant. Details of the recipes prepared using the selected crops was gathered through the field survey. In total 11 spices have been identified which are being used in the preparation of recipes. These spices are useful for human consumption as well as from medicinal point of view also. Among the general food preferences, it was found that for food the villagers are lean towards the pulses which are not grown in the area i.e. pigeon pea, red lentil, chick pea (Figure 11). These are mainly purchased from the market. Among the traditional crops, horse gram, black soybean, and red kidney bean (rajma) is popular for making food.

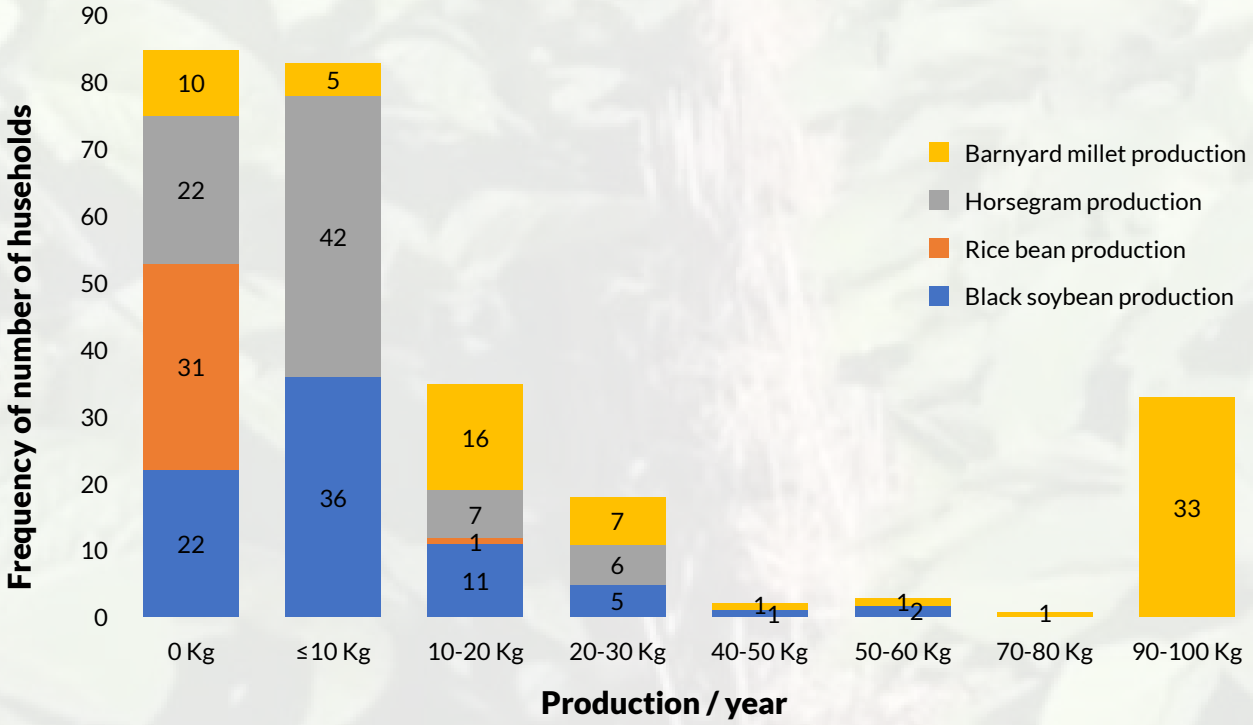


Figure 10: Annual Production of Selected Crops (Kg/Year) by the marginalized community people of selected villages

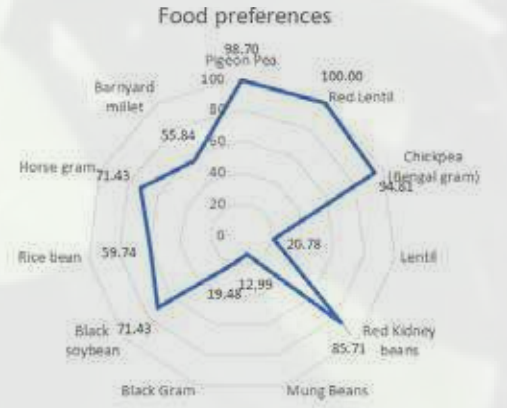
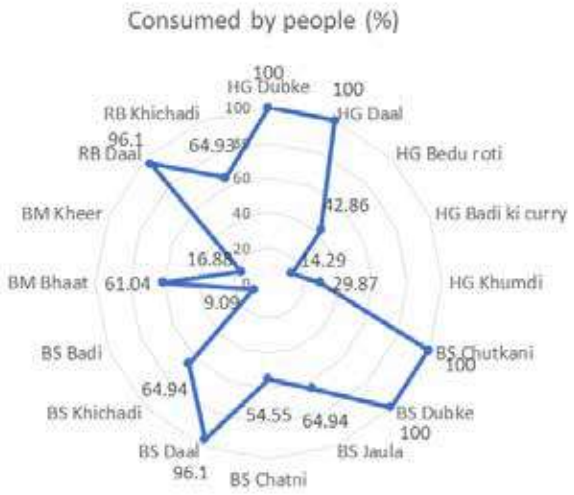


Figure 11: Food grain preferences, except rice and wheat, among marginalized community people of selected villages

Through FFQ,details of cuisines prepared using these crops were also documented. It was observed that maximum number of recipes are prepared using black soybean. Horse gram is mainly consumed in the form of daal and dubke, rice bean for khichdi, black soybean in the form of chudkani and dubke, and barnyard millet as bhatt (Figure 12). Horse gram is believed to have kidney stone breaking power as believed by local villagers (Bhartiya, Aditya, & Kant, 2015; Panwar & Dubey, 2016; Rana and Agnihotri, 2018), barnyard millet is beneficial in diabetes (Ugare, Chimmad, & Naik, 2011), whereas rice bean (Bajaj, 2014; Hoque, Wadikar, Borah, & Patki, 2017), a nd black

soyabean (Patel & Pandya, 2014) have high nutritional properties.

Documentation of methods used for cooking was investigated as it affects the nutritional composition of cuisines and it was found that generally cooking is



12: Analysis of popularity of traditional recipes *(Number of households=77)*
BM: barnyard millet; BS: black soybean; RB: rice bean; HG: horse gram

carried out either through traditional chulha's, or by using gas stoves. In the year 2017, 56 % people from marginalized community has responded that they use chulhas over gas stove, while in the year 2020 their percentage was decreased to 19% (Figure 13). The percentage of people using both chulha and gas stove had increased to 64% from 11% in the year 2017. This shows the effect of Ujjwala yojana

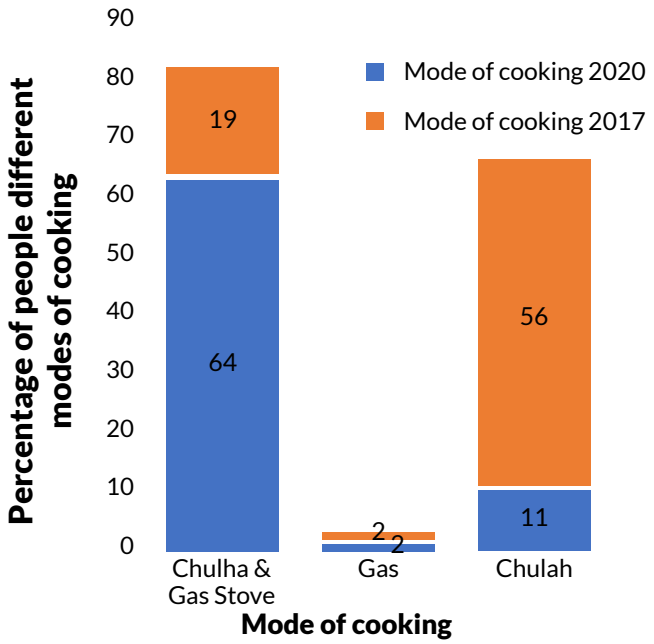


Figure 13: Changes in mode of cooking between 2017 to 2020

TRADITIONAL FOODS: PREPARATION AND ANALYSIS

Figure 14. Food processing and further analysis

All the ingredients of the traditional cuisines (Table 1) were purchased from the villagers as well as from the local market.The nutrient content such as protein, carbohydrate, fat content, ash content, crude fibre, minerals, total phenolic and flavonoid content, antioxidant activity of raw materials were analysed following Association of Official Analytical Chemists (AOAC, 2016) methods and other relevant standard methodology. The schematic diagram is shown in Figure 15. The nutrient data of the targeted grains was compared with that of other grains (as per USDA data) consumed by marginalized community people as per the survey data (Figure 16). Among the marginalized community people residing in the selected villages, Mrs. Parvati Devi, from Katarmal village was selected for cooking of traditional foods after discussion with the gram Pradhan and Asha workers

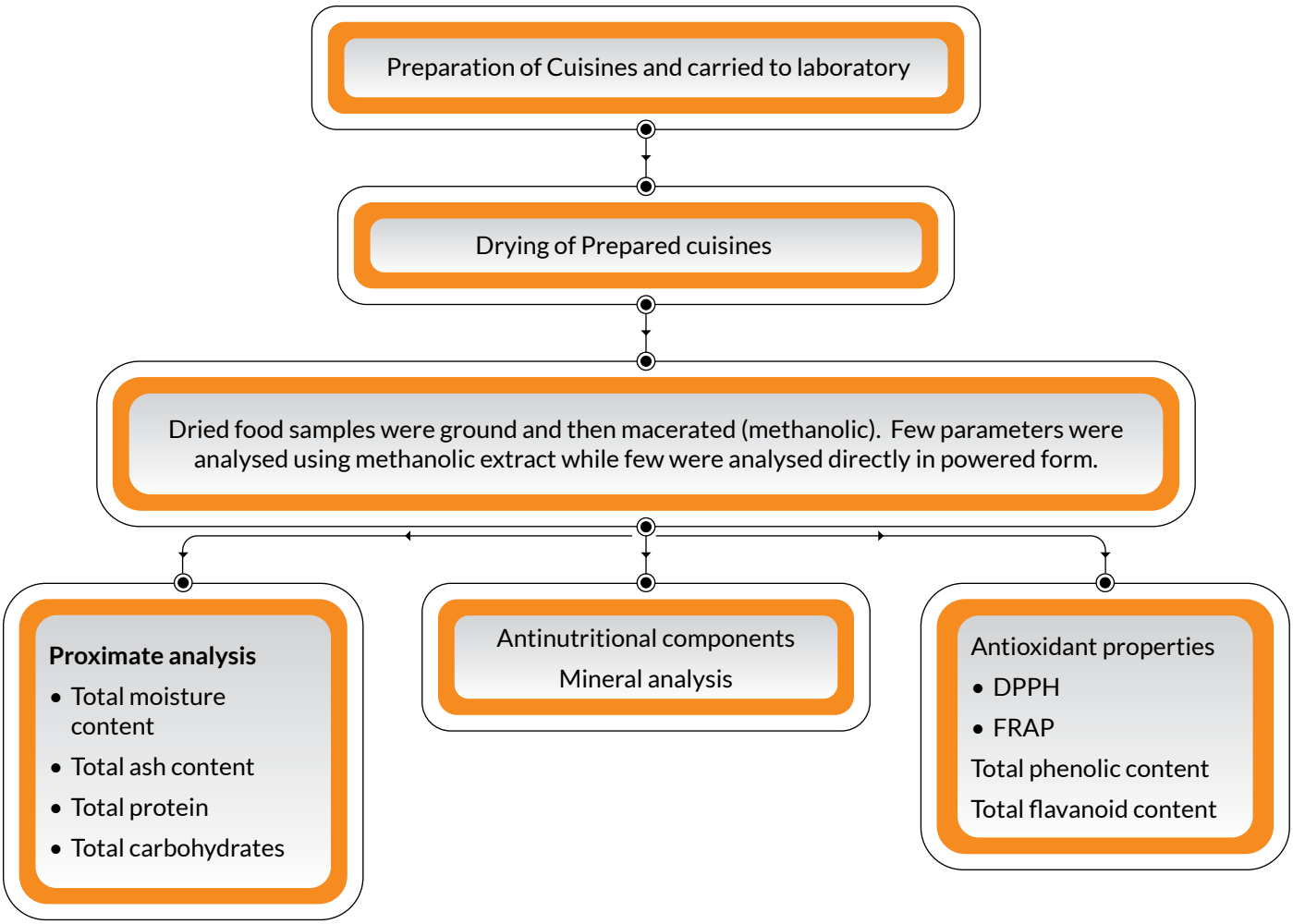


Figure 15: Steps followed during the processing and nutritional analysis of cuisines

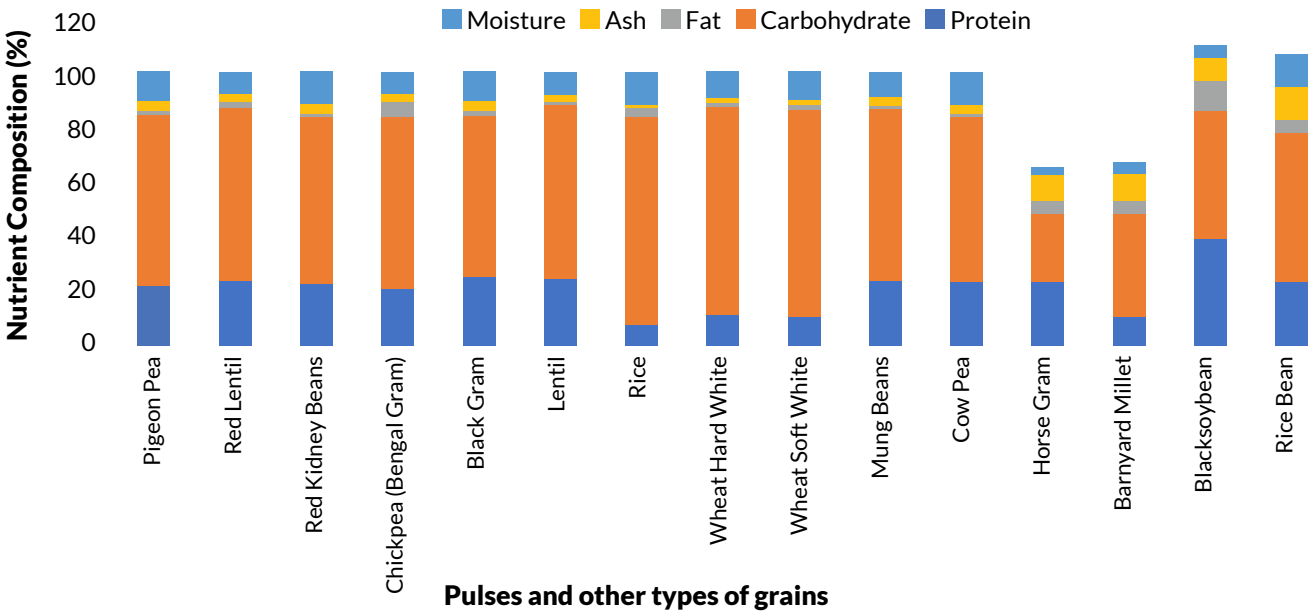


Figure 16: Proximate nutritional composition of food grains generally taken by the SC people *(USDA data)* and their comparison with the traditional grains grown in the study area

Nutritional journey of traditional foods of Uttarakhand

SAMPLE PROCESSING

All the cuisines were prepared following traditional methods followed by the targeted community, some of which are presented pictorially in the upcoming contents through the Figure 17- 27 and Table 2 to 12.

Horse gram (Gahat)

Gahat ke dubke

Figure 17: Preparation method of Gahat ke dubke

Table 2. Nutritional profile of Gahat ke dubke

Nutrients	Amount
Protein (%)	14.94
Carbohydrate (%)	45.70
Total Fat (%)	27.98
Moisture (%)	84.39
Ash (%)	1.06
Crude fibers (%)	11.63
Sodium (%)	1.092
Potassium (%)	0.694
Iron (%)	0.06
Phosphorus (%)	0.43
Tannin Content (%)	3.28
Phytate (%)	4.19
Oxalate (%)	0.07

Ingredients used

Gahat (soaked and grinded), oil, onion, salt, red chilli pepper, garlic, turmeric, coriander powder, water.

Gahat ki daal

Figure 18: Preparation method of Gahat ki daal

Table 3. Nutritional profile of Gahat ki daal

Nutrients	Amount
Protein (%)	20.26
Carbohydrate (%)	44.47
Total Fat (%)	9.28
Moisture (%)	72.97
Ash (%)	1.44
Crude fibers (%)	85.66
Sodium (%)	1.035
Potassium (%)	0.868
Iron (%)	0.08
Phosphorus (%)	0.57
Tannin Content (%)	5.15
Phytate (%)	4.36
Oxalate (%)	0.07

Ingredients used

Gahat (seeds), oil, onion, garlic, tomato, cumin, salt, red chilli pepper, garlic, turmeric, coriander powder, water.

Gahat ki Khichdi (Khumdi)

Figure 19: Preparation method of Gahat ki khichdi

Table 4. Nutritional profile of Gahat ki Khichdi

Nutrients	Amount
Protein (%)	12.09
Carbohydrate (%)	48.13
Total Fat (%)	9.73
Moisture (%)	71.67
Ash (%)	14.66
Crude fibres (%)	2.48
Sodium (%)	1.786
Potassium (%)	0.415
Iron (%)	0.03
Phosphorus (%)	0.41
Tannin Content (%)	1.93
Phytate (%)	3.39
Oxalate (%)	0.05

Ingredients used

Gahat (fried) or Gahat (boiled), rice, oil, onion, garlic, tomato, cumin, salt, red chilli pepper, garlic, turmeric, coriander powder, water.

Gahat ki Bedu Roti and Puri

Figure 20: Preparation method of Gahat ki Bedu Roti and Poori

Table 5. Nutritional profile of Gahat ki bedu roti and puri

Nutrients	Bedu roti	Bedu puri
Protein (%)	15.47	14.33
Carbohydrate (%)	55.94	51.36
Total Fat (%)	0.28	15.75
Moisture (%)	38.63	38.23
Ash (%)	1.47	1.12
Crude fibres (%)	2.64	3.31
Sodium (%)	0.349	0.348
Potassium (%)	0.592	0.578
Iron (%)	0.15	0.02
Phosphorus (%)	0.74	0.90
Tannin Content (%)	0.00	2.50
Phytate (%)	5.15	4.61
Oxalate (%)	0.05	0.08

Ingredients used

Gahat (Soaked and Grinded), oil, red chilli powder, salt, wheat flour, water, and (oil in case of puri)

Gahat ki Badi ki Sabji

Figure 21: Preparation method of Gahat ki badi ki sabji

Table 6. Nutritional profile of Gahat ki badi ki sabji

Nutrients	Amount
Protein (%)	15.14
Carbohydrate (%)	46.79
Total Fat (%)	0.29
Moisture (%)	70.35
Ash (%)	2.41
Crude fibres (%)	8.63
Sodium (%)	1.212
Potassium (%)	1.070
Iron (%)	0.13
Phosphorus (%)	0.65
Tannin Content (%)	0.00
Phytate (%)	3.69
Oxalate (%)	0.40

Ingredients used

Gahat (soaked and grinded), guard vegetable, papad leaves, oil, onion, tomato, cumin, potato, salt, red chilli pepper, garlic, turmeric, coriander powder, water.

Gahat ki Chatni

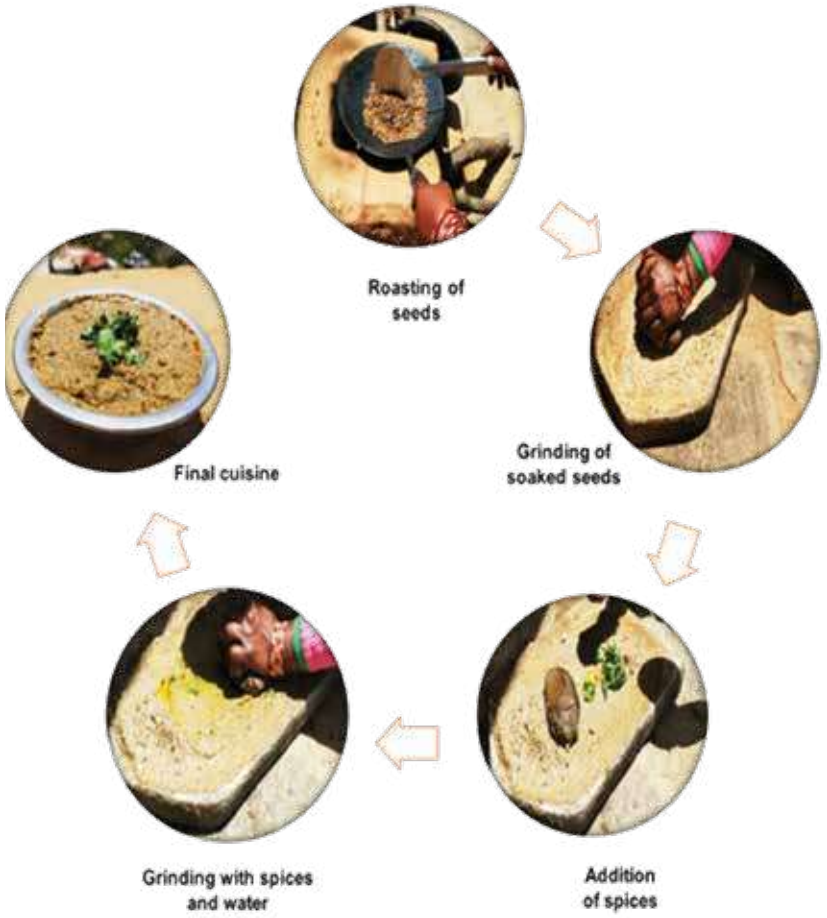


Figure 22: Preparation method of Gahat ki chatni

Table 7. Nutritional profile of Gahat ki chatni

Nutrients	Amount
Protein (%)	23.30
Carbohydrate (%)	47.79
Total Fat (%)	0.29
Moisture (%)	70.35
Ash (%)	2.41
Crude fibres (%)	10.69
Sodium (%)	1.943
Potassium (%)	1.159
Iron (%)	0.20
Phosphorus (%)	1.05
Tannin Content (%)	4.30
Phytate (%)	4.32
Oxalate (%)	0.14

Ingredients used

Gahat seeds (roasted), garlic, chilli powder, cumin, clove, salt, water.

Black Soybean (Bhat)

Bhat ki Chudkani

Figure 23: Preparation method of Bhat ki chudkani

Table 8. Nutritional profile of Bhat ki chudkani

Nutrients	Amount
Protein (%)	28.35
Carbohydrate (%)	2.73
Total Fat (%)	24.65
Moisture (%)	1.19
Ash (%)	0.89
Crude fibres (%)	3.20
Sodium (%)	1.197
Potassium (%)	0.895
Iron (%)	0.05
Phosphorus (%)	0.49
Tannin Content (%)	0.30
Phytate (%)	3.12
Oxalate (%)	0.06

Ingredients used

Bhatt (seeds), oil, onion, wheat flour, salt, red chilli pepper, cumin, turmeric, black chilli pepper, coriander powder, water.

Bhat ke Dubke

Figure 24: Preparation method of Bhat ke dubke

Table 9. Nutritional profile of Bhat ke dubke

Nutrients	Amount
Protein (%)	29.22
Carbohydrate (%)	2.83
Total Fat (%)	21.96
Moisture (%)	82.92
Ash (%)	0.84
Crude fibres (%)	3.02
Sodium (%)	1.326
Potassium (%)	0.822
Iron (%)	0.06
Phosphorus (%)	0.30
Tannin Content (%)	0.09
Phytate (%)	3.10
Oxalate (%)	0.03

Ingredients used

Bhatt (soaked and grinded), oil, onion, flour (wheat or rice), salt, red chilli pepper, garlic, turmeric, coriander powder, jambu, gandharein, water

Bhat ka Jaula

Figure 25: Preparation method of Bhat ka jaula

Table 10. Nutritional profile of Bhat ka jaula

Nutrients	Amount
Protein (%)	21.00
Carbohydrate (%)	3.32
Total Fat (%)	20.84
Moisture (%)	81.86
Ash (%)	0.28
Crude fibers (%)	6.52
Sodium (%)	1.865
Potassium (%)	4.974
Iron (%)	0.04
Phosphorus (%)	0.32
Tannin Content (%)	0.18
Phytate (%)	3.14
Oxalate (%)	0.06

Ingredients used

Bhatt (soaked and grinded) sometimes grinded directed without soaking, rice, salt (may or may not), water

Barnyard Millet (Jhangora)
Jhangore ka Bhat

Figure 26: Preparation method of Jhangore ka bhat

Table 11. Nutritional profile of Jhangore ka bhat

Nutrients	Amount
Protein (%)	10.10
Carbohydrate (%)	45.85
Total Fat (%)	2.88
Moisture (%)	73.74
Ash (%)	0.82
Crude fibers (%)	0.61
Sodium (%)	0.049
Potassium (%)	0.030
Iron (%)	0.00
Phosphorus (%)	1.74
Tannin Content (%)	0.70
Phytate (%)	3.29
Oxalate (%)	0.05

Ingredients used

Jhangora rice (roasted), water

Jhangore ki Kheer

Figure 27. Preparation method of Jhangore ke kheer

Table 12. Nutritional profile of Jhangore ki kheer

Nutrients	Amount
Protein (%)	10.21
Carbohydrate (%)	40.14
Total Fat (%)	0.54
Moisture (%)	68.51
Ash (%)	1.47
Crude fibres (%)	0.39
Sodium (%)	0.124
Potassium (%)	0.026
Iron (%)	0.04
Phosphorus (%)	1.80
Tannin Content (%)	0.21
Phytate (%)	3.19
Oxalate (%)	0.02

Ingredients used

Jhangora (roasted), sugar, ghee, milk, available dry fruits

Processing of food samples prior analysis

Drying of prepared food

All the prepared food samples were brought back to the laboratory for further processing in a sterilized steel box. The moisture content was estimated for the fresh samples. The rest of the samples were immediately dried on a water bath/ vacuum oven (Figure 28).

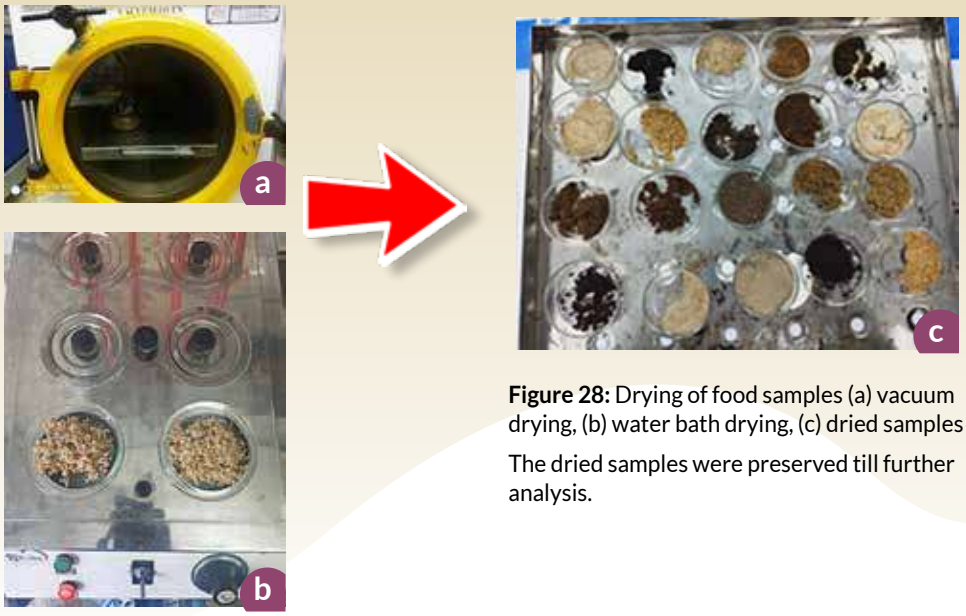


Figure 28: Drying of food samples (a) vacuum drying, (b) water bath drying, (c) dried samples

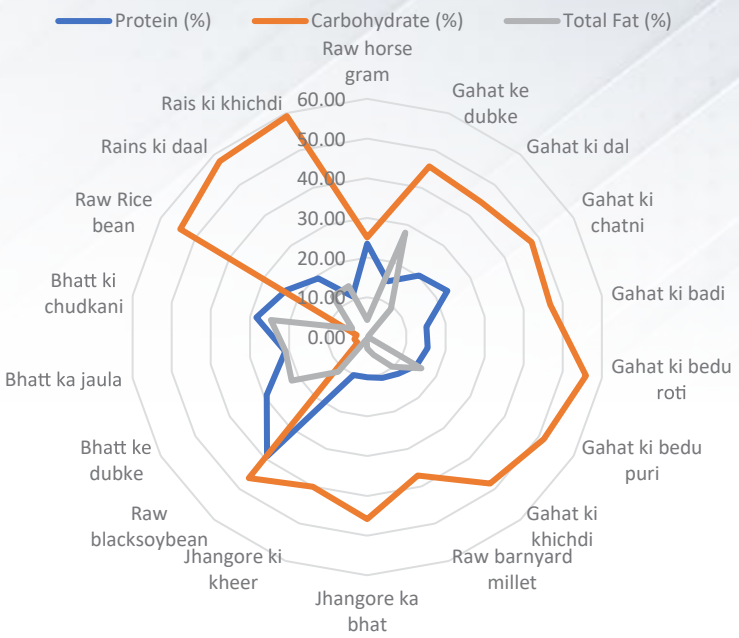
The dried samples were preserved till further analysis.

Nutritional analysis of samples

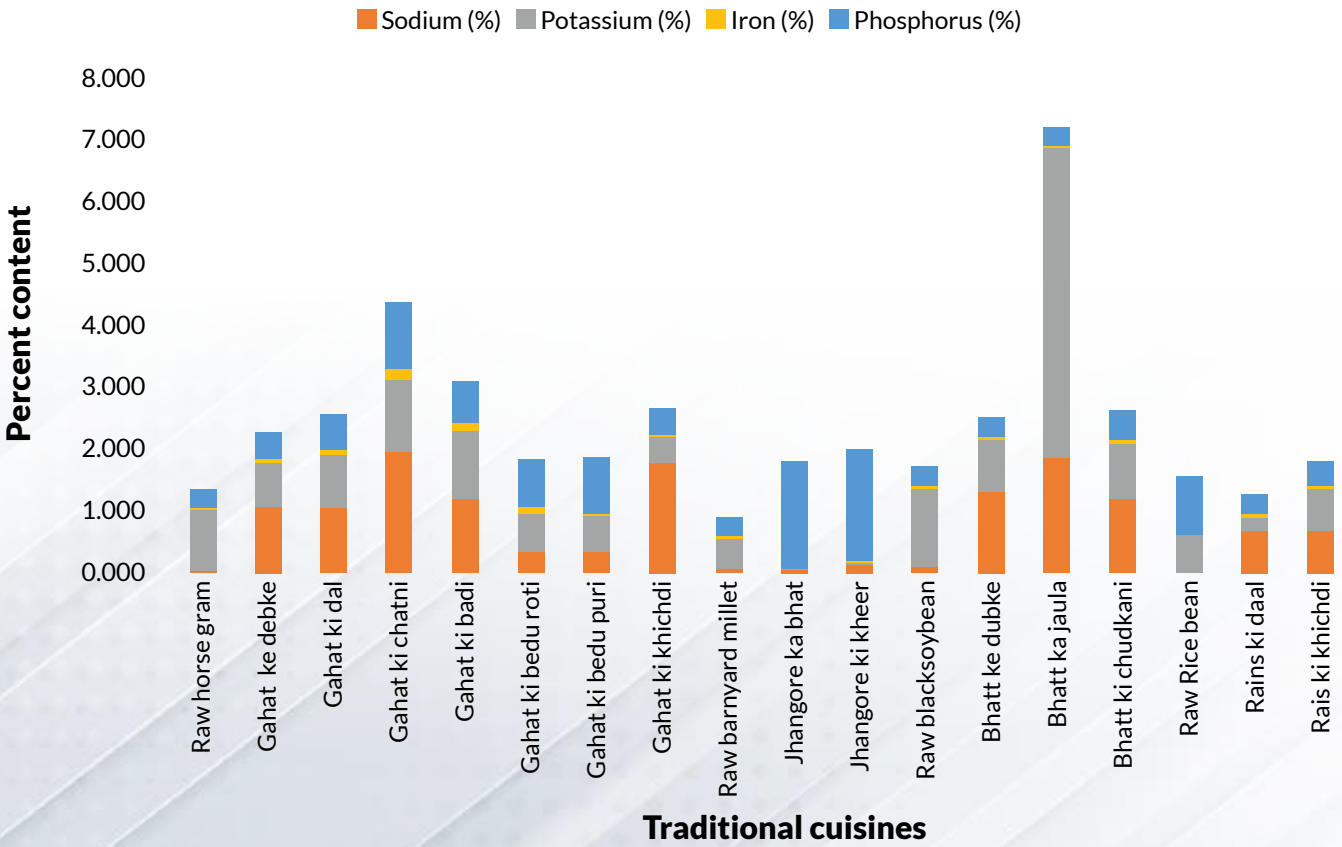
The nutritional composition and other phytochemical analysis were conducted following the standard AOAC and other similar methods. As per figure 29 (a), the nutrient content of selected grains (horse gram, barnyard millet, black soybean and rice bean) in terms of protein, carbohydrate, fat, ash and moisture content was found equivalent or higher than the grains generally consumed by marginalized community people. The comparison was done based on USDA nutritional datasets available for other grains.

After the nutritional analysis, it was observed that the raw grains of black soybean have higher amount of protein, crude fat, sodium, potassium and iron content (Figure 29 (b)), and oxalate content (Figure 30); rice bean has highest amount of carbohydrate, phosphorus (Figure 29 (b)), tannin (Figure 30), phenolic and flavonoid content (Figure 31); horse gram has shown highest FRAP and DPPH activity (Figure 32) and barnyard millet had shown highest phytate (Figure 30) content among all the raw grains.

Cuisines made up of black soybean has highest amount of protein among all the recipes. Very less reduction of protein was observed in case of recipes prepared using horsegram as raw ingredient. Ricebean recipes have high amount of carbohydrate among all the cuisines. Total fat is highest in gahat ke dubke, while recipes made up of using black soybean have high amount of total fat among all the recieps (Figure 29 (a)). Bhat ka jaula has highest amount of potassium. Iron content is highest in gahat ki chatni. As per the heat map shown in Table 2, all the selected cuisines are equally nutritious in terms of selected parameters. There is a significant variation among the cuisines in terms of ash content, total fat, potassium, tannin content, FRAP activity. Although the variation is not significant for all the recipes.



(a)



(b)

Figure 29 (a) and (b): Nutritional composition of traditional cuisines consumed by marginalized communities

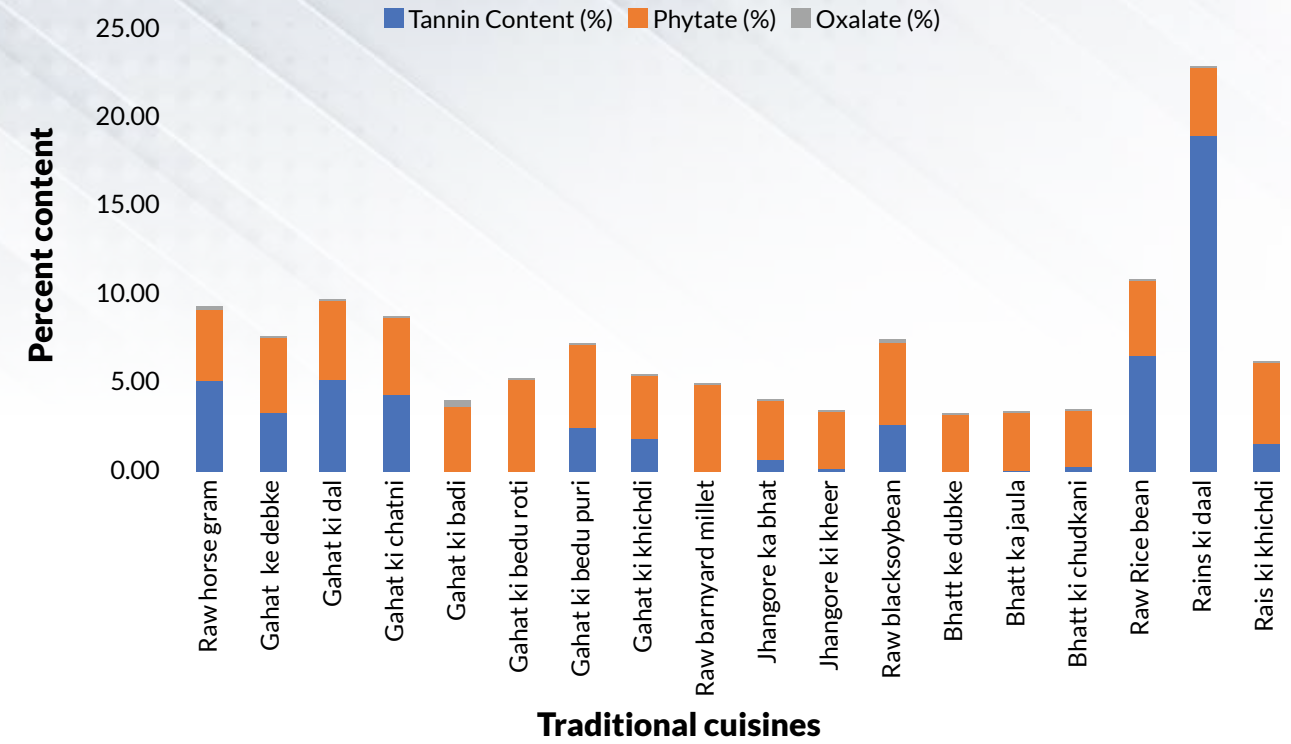


Figure 30: Antinutrient contents of traditional cuisines

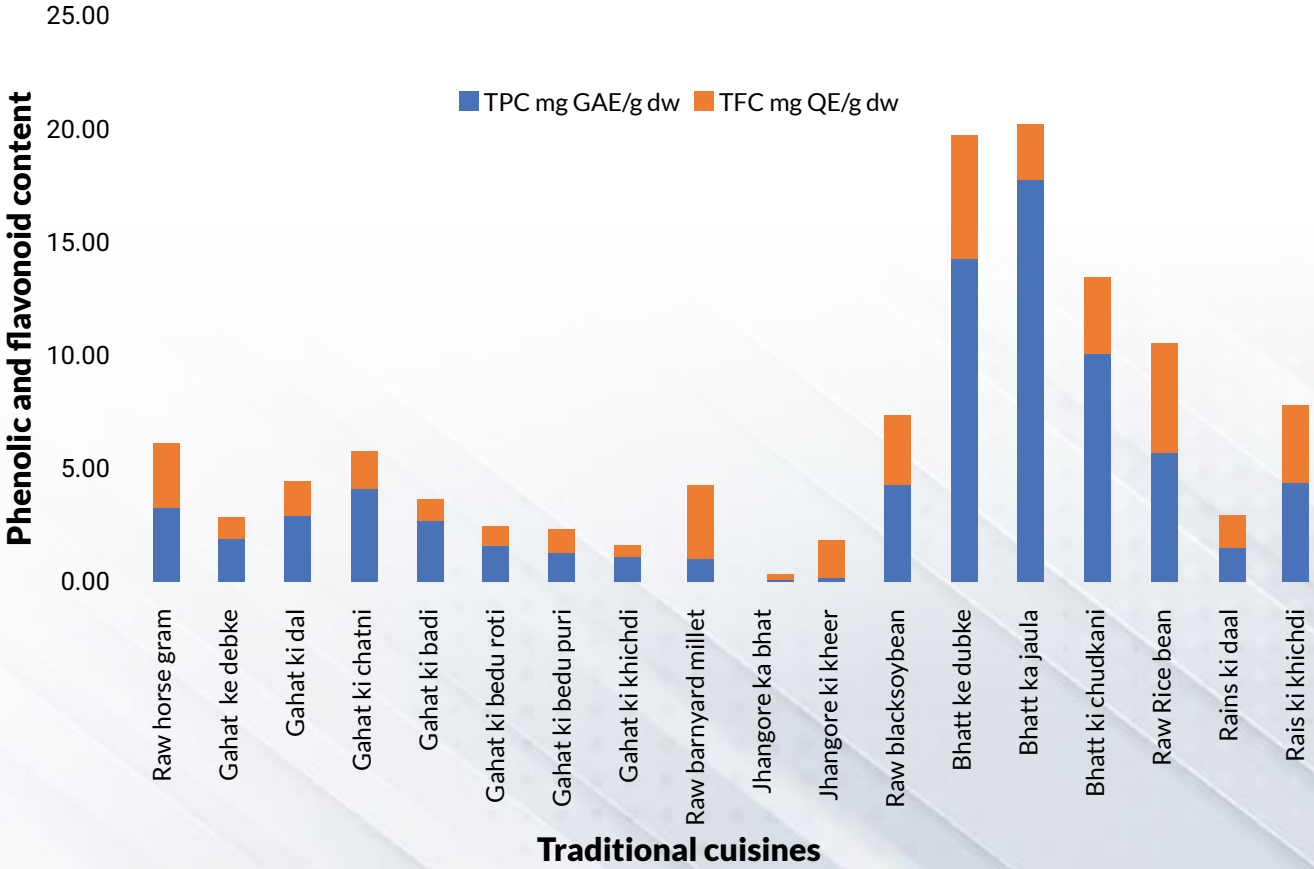


Figure 31: Phenolic and flavonoid contents of traditional cuisines

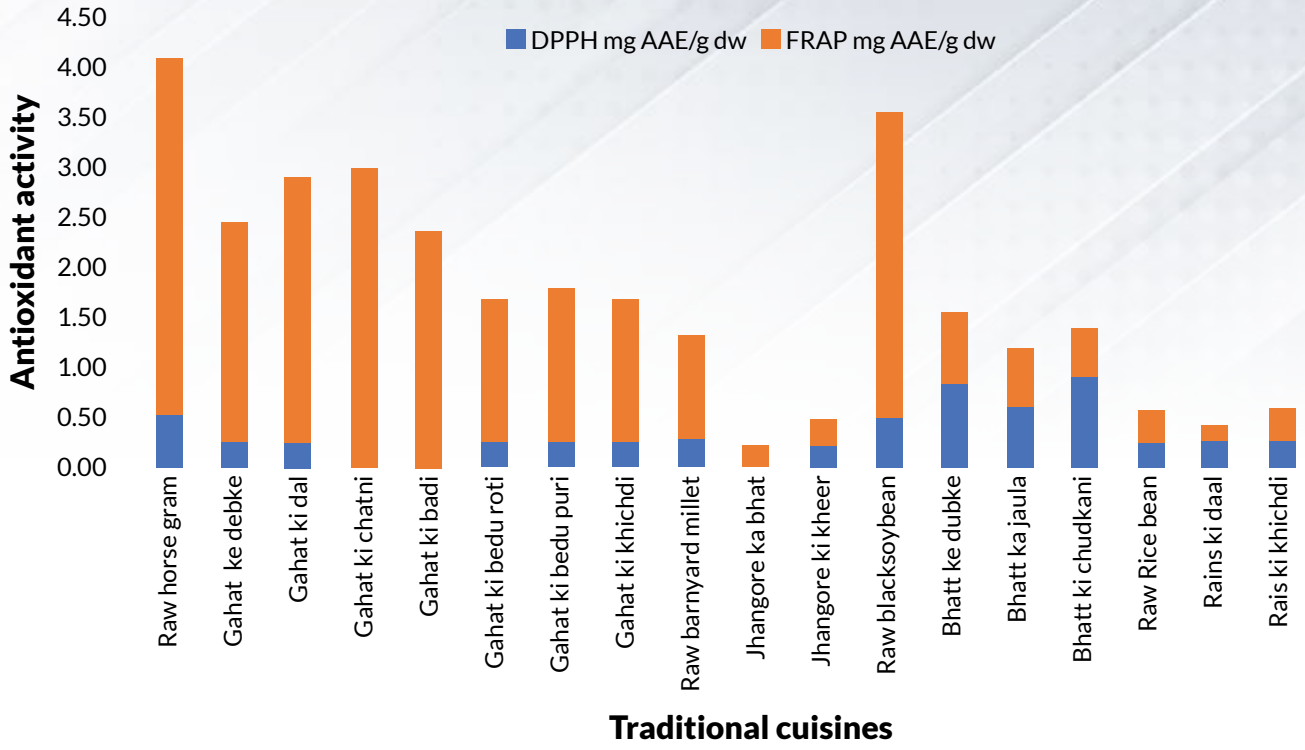


Figure 32: Antioxidant activity of traditional cuisines used by marginalized communities

Table 2: Heat map showing the nutritional composition of traditional cuisines

Samples	Protein (%)	Carbohydrate (%)	Total Fat (%)	Moisture (%)	Ash (%)	Crude fibers (%)	Sodium (%)	Potassium (%)	Iron (%)	Phosphorus (%)	Tannin Content (%)	Phytate (%)	Oxalate (%)	TPC mg GAE/g dw	TFC mg QE/g dw	DPPH mg AAE/g dw	FRAP mg AAE/g dw
Raw horse gram																	
Gahat ke dubke																	
Gahat ki dal																	
Gahat ki chatni																	
Gahat ki badi																	
Gahat ki bedu roti																	
Gahat ki bedu puri																	
Gahat ki khichdi																	
Raw barnyard millet																	
Jhangore ka bhat																	
Jhangore ki khichdi																	
Raw blacksoybean																	
Bhatt ke dubke																	
Bhatt ka jaula																	
Bhatt ki chudkani																	
Raw Rice bean																	
Rains ki daal																	
Rais ki khichdi																	

AWARENESS PROGRAM

Awareness program with the local stakeholders organized where the local stakeholders (villagers) were invited for the discussion meetings. Women of marginalized communities had participated in large numbers along with their children. Following points were highlighted by the stakeholders:

Cause of less interest in eating traditional cuisine is easy availability of food grains from ration system and interest of younger generation towards fast food and other easily available food items

Cause of less cultivation of traditional drought resistant crop is low land holding by marginalized community (SC) people; and who have land, raised the issue of human wildlife conflict makes the agriculture, less economically beneficial.

Plate 2: Meetings with the stakeholders

RECOMMENDATIONS AND WAY FORWARD

Through the meeting with the experts and based on the finding of the project, following recommendations were outlined:

1. Awareness creation of the traditional agricultural crops and foods is required in order to promote nutritional security, for boosting economy and to prevent diseases

2. Millet and pseudo cereal ingredient (known as superfoods) may be incorporated in Public Distribution System (PDS). Food items prepared using these crops may be incorporated as mid-day meal scheme under Integrated Child Development Scheme (ICDS).

3. Integrated approach for understanding relation among livelihood, tourism, and regional foods need to be looked in more innovative and wholistic way

The marginalized communities residing in the selected villages of Almora district North-west Indian Himalayan state (Uttarakhand) were found in good condition in terms of their sex ratio, literacy status but economically marginalized. As agriculture is the backbone of the Indian economy, and the Indian Himalayan region is agro-ecologically suitable for the cultivation of traditional drought resistant and

nutritionally very rich food crops, such as horse gram, barley, millet, sorghum, rice-bean, buckwheat, black soybean etc. However, the cultiation of these crops are declining over

the years. Therefore, the reisanurgent need to encourage the local stocultivate these crops for the irpromotion and conservation. Especially, encouragement is required for scheduled community persons to fulfill their nutrition and food needs. It is suggested that, if these crops can be made in regular ration system by the government, then these crops will again be cultivated by the villagers, however initially this cultivation is required to be protected through some economic inputs from the government. The increased demands of these Himalayan crops and an organized market will definitely attracts the attention of youth residing in these areas to opt agriculture for livelihood and economic generation. This will also reduce out migration from these areas.

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About the Institute:

G.B. Pant National Institute of Himalayan Environment, Kosi-Katarmal, Almora was established in 1988, during the birth centenary year of Bharat Ratna Pt. Govind Ballabh Pant, as an autonomous Institute of the Ministry of Environment, Forest & Climate Change (MoEF&CC), Govt. of India. The institute has been identified as a focal agency to advance scientific knowledge, to evolve integrated management strategies, demonstrate their efficacy for conservation of natural resources, and to ensure environmentally sound development in the entire Indian Himalayan Region (IHR).

The Institute follows a multidisciplinary and holistic approach in all its Research and Development programmes with emphasis on interlinking natural and social sciences and particular attention is given to the conservation of fragile mountain ecosystems, indigenous knowledge systems and sustainable use of natural resources. Training, environmental education and awareness to different stakeholders are essential components of all the R&D programmes of the Institute.

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