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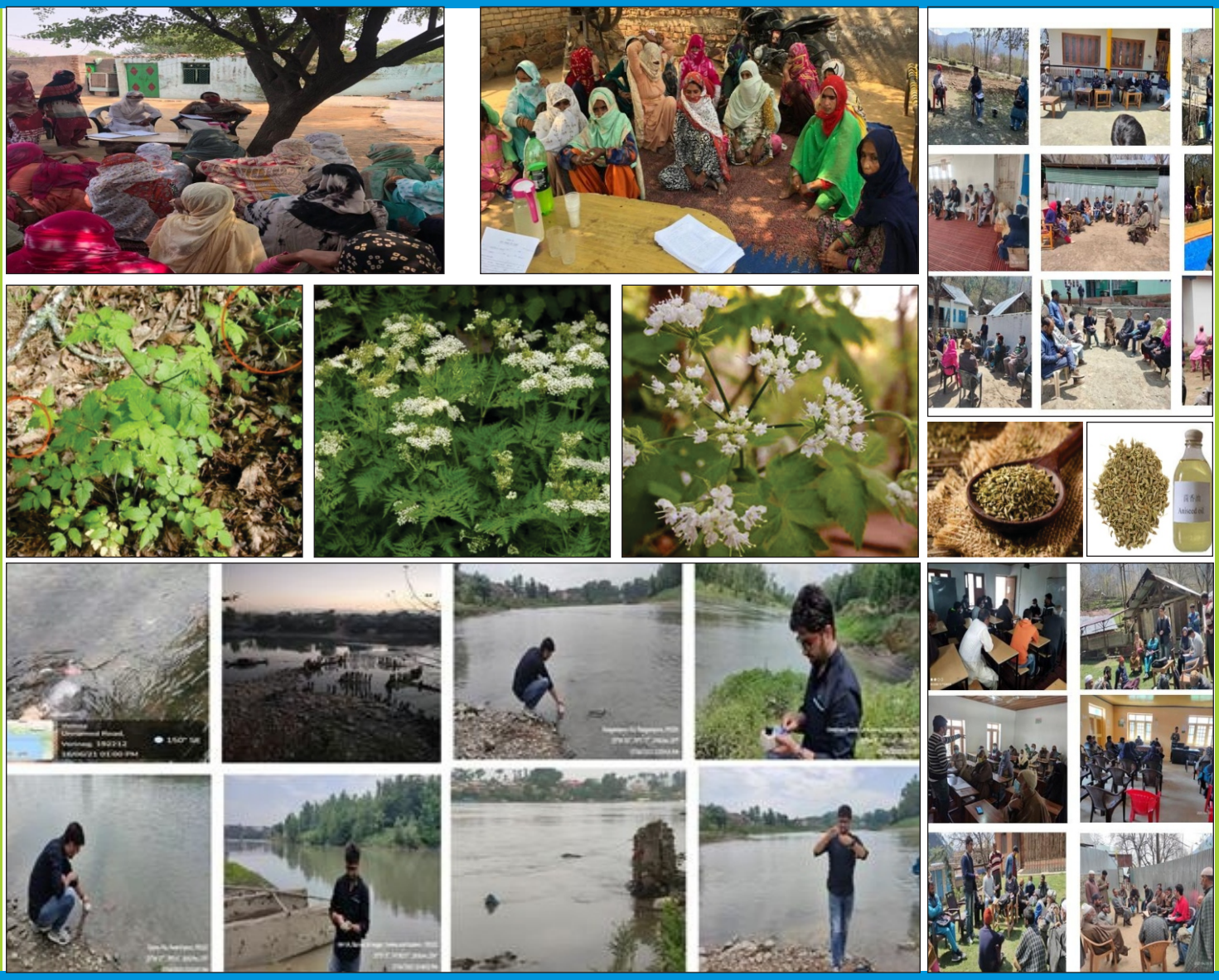

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The IJEHS is an official publication of Save The Environment (STE). It publishes peer reviewed quarterly, original articles (Research paper, Review articles, Short Communication, Case studies, etc.) related to all fields of Environment and Health Sciences. It disseminates the scientific research and recent innovations.

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International Journal of Environment and Health Sciences

From The Editor's Desk…

The year 2020 was a difficult year for the mankind, but at the same time, it made us all realize that the power of unity and discipline is of utmost importance while managing the severest of crises. The COVID-19 pandemic impacted public health and environment alike. However, the year 2021 is being deemed to be the 'Year of Recovery'. All of us need to join hands together to tackle the aftermath of the pandemic and to ensure that we stay firm in our efforts to create a sustainable environment.

Surveys suggest that in order to ensure a better respiratory capacity and overall improved health, the necessity of clean air and pure water needs to be addressed more now than ever before. Perils linked to environmental risk factors have to be managed for a bluer and greener earth. In this outlook, propagating awareness for environmental sustainability has become the need of the hour. Formation of regulatory bodies and authorities to disseminate societal alertness towards environmental safety is on the rise.

With this perspective, the International Journal of Environment and Health Sciences (IJEHS) proposes to provide a reliable platform to discuss technologies and strategies for management of aforesaid environmental matters, especially for the current post-COVID-19 period. IJEHS will be quintessential to academicians, industry professionals and researchers who are actively engaged in the areas of environmental issues and related health effects. We are pleased to inform that ISSN for IJEHS is available as 2582-5283. IJEHS is referenced in Crossref, the official Digital Object Identifier Agency (doi 10.47062). IJEHS is now also indexed in the International Scientific Indexing (ISI).

We invite original research articles, short communications and critical reviews directed towards an academic, clinical and industrial audience. The first section of the journal focuses on burning environmental issues like pollutants and their fate, waste management, resource conservation, remediation technologies, etc. The second section includes all topics relevant to physiological impact of environmental risk factors and application of alternative medicinal approaches as remedial measures. Detailed scope can be found in the home page of the journal (www.stenvironment.org/journals). Notes on development of any novel and validated strategy or tool to address environmental challenges are welcome. Discussion on proceedings of conferences conducted on environmental themes and related health aspects will also be considered.

All submissions will be meticulously scrutinized by pioneers in the field to ensure publication of only articles of high quality and relevance. Authors are requested to take special precautions to avert plagiarism and redundancy. It is high time that we realize the gravity of circumstances and take potent steps to undo the adversities already triggered. In this pursuit, IJEHS expects to be the ideal platform to discuss sustainable ideas and potential solutions.

We thank all authors who have contributed to the journal and have consistently been with us in the past year. I hope our audience and patrons shall come together in this effort to promulgate their part in resurrecting our valuable environment.

Dr. Kshipra Misra
Editor-in-Chief, IJEHS

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A.
Environmental Sciences Section

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AWARENESS GENERATION AMONG THEMASSES THROUGH COMMUNITY PARTICIPATION: CASE STUDY OF NIZAMPUR VILLAGE, MEWAT AREA

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Abstract
Environmental awareness generation is the most effective tool to bring about a change in society with respect to cleanliness, environmental health, hygiene, social stigmas stigmas, taboos and so on. For bringing about environment awareness in the society, programs can be executed through “folk songs, nukkad-natak, folk dance, and pamphlet distribution, advertisement vehicles, creating and distributing appropriate information, education and communication (IEC) material to targeted beneficiaries. Awareness generation can be of various types. It depends primarily on the theme which it focuses on. They include the following: Behavioral Change programs, social stigmas redressal, personality development programs, environmental awareness, and financial literacy programs. Behavioral change programmes primarily aim to change the beneficiaries' attitudes or behaviours. Maintaining a clean environment, for example, and changing the practise of defecating in the open. We have dealt with such ground-level awareness efforts in our research. The study presents its findings in the form of case studies. Social stigma redressing programmes are frequently linked to discrimination and exclusion, as well as a lack of education and awareness among the general public. Stigma can be a danger and a roadblock to a country's growth. Health emergencies, such as the Covid-19 outbreak, have resulted in social stigma and discrimination against persons of various ethnic backgrounds. Similarly, awareness programs focusing on environmental issues, financial literacy, and personality development (Skill development) basically involve active participation of community as well as the trainers or facilitators to get the best results.

Some awareness programmes were held on a regular basis in the village in question. Further research reveals a shift in community behaviour. Because the process of raising awareness is inclusive, it engages people from all walks of life. Meanwhile, adolescent girls, children, mothers, and the elderly are the true beneficiaries. Changes in behaviour, cleanliness of the environment (environment), lower disease transmission rates, reduced social stigmas and taboos, lower school dropout rates, and effective menstrual hygiene management are all examples of the effects. In a word, we can state that successful implementation of environmental awareness programmes requires active community participation.

Keywords
Environmental health, hygiene, sanitation.

INTRODUCTION

The term "environment" refers to everything that surrounds us. It can change depending on social, biological, or geographical circumstances. It shapes a person's perspective on society. From childhood to old age, the environment plays a critical influence in human development.People develop their daily habits as per their milieu. If we talk about environment in terms of sanitation and cleanliness we get

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Color versions of one or more of the figures in this article can be found online at www.stenvironment.org

very disappointing results from our country as most of the population lack adequate awareness about the benefits of using toilet and maintaining sanitation. Many of them continue to practice open defecation, which can result in fatal infections such as cholera, typhoid, and amoebic dysentery, as well as hepatitis. Amoebic dysentery is highly correlated with open defecation and geography of the area in question. On the same lines hepatitis E spreads through drinking water contaminated by human feces. On the other hand when we talk about sanitation among adolescent girls and women again we get unsatisfactory and disappointing results. With the goal of making India open-defecation free by 2019, the government launched the Swachh Bharat Abhiyan (SBA) program in 2014.Under the program, people living below and above poverty line can avail reimbursement for constructing toilets at the household level. The program has given a huge impetus to the nationwide toilet building exercise (SBM Guidelines, 2017).

The Swatch Bharat Abhiyan (SBA), currently, operates under a reimbursement model, where the households are expected to build the toilets from their own funds and then, upon producing the required documents, they are reimbursed Rs 12,000- Rs 15,000(SBM Guidelines, 2017).Despite, the process of household toilet construction through SBA subsidies, Below Poverty Line BPL households has faced significant barriers. There are many more schemes like this which produced tremendous results in India but still there are few situations in which people are not accepting the use of toilets and practice open defection. The national Annual Rural Sanitation Survey (NARSS), 2019-20, that surveys 92,010 households and occurs more often than the NFHS, indicates that 94% of the households have toilet access and is used by 95% of individuals, said an official at DDWS requesting anonymity.

Approximately 70% of the Indian population belong to an agricultural background. We cannot progress and be considered a developing nation unless the people of rural areas are awakened. Environmental education and awareness in villages includes a broader approach which should overcome the common perception of education and information in schools, colleges etc. Environmental awareness must ensure participation and learning for people of all ages. To create awareness among the general masses in villages about environment, it is important to understand first what people know, think and believe about the environment. Environmental awareness requires special focus with reference to the areas, communities, and cultures. In order to create environmental awareness among the common masses in villages, various awareness methods can be used such as community meetings, cultural activities, street plays, puppetry, and interactions at religious congregations. Media, both electronic and print in local languages plays an important role in creating awareness about environmental issues. Protection of the environment and its resources is not the sole responsibility of one section, one religion or one group but it is the responsibility of the whole society/nation. There is an urgent need for awareness and sanitation literacy as people face several health issues such as uro-genital infection, yeast infection urinary infection and cervical cancer due to improper and unclean sanitation facilities (Phillips-Howard et al. 2011).Recently, studies on open defecation in rural Bihar, as well as the socioeconomic and political causes for this practice, have been reported (Jain et al. 2020).The need of the hour is to spread awareness among the rural population by changing their mindset and behavior in maintaining environmental health and hygiene.

We organised some awareness programmes for this study to reach a wider audience and have a better impact. During our initial visits to Mewat, we discovered that certain neighbourhoods lacked sanitation facilities. In the community, there is a wide spectrum of stereotypes. People in certain locations have the resources, but they are not prepared to use and maintain them. We noticed that people continue to defecate in the open after our initial intervention. To determine the likely reasons, we conducted a survey and impact assessment. Our data show that there is a link between ignorance or lack of awareness and open defecation. We devised several public awareness campaigns targeted at influencing people's attitudes. The first step involved approaching the sarpanch of the gram panchayat and appraising him/her about the objectives of the project. The gram panchayat members and aanganwadi workers were also involved for greater community participation. Secondly, we conducted behaviour change campaigns once a week. These were carried out at an individual level through training at home, community level at gram sabha, anganwadi centres through folk songs, folk dance, and other audio-video mediums. Thirdly, we organized workshops and seminars for school going children in their schools for disseminating the knowledge and know-how about maintaining the good personal hygiene, menstrual hygiene management, clean and neat surroundings through school sanitation clubs. Fourth, delivering free sanitary pads and IEC (Information, Education, and Communication) materials to women of reproductive age, including information on correct sanitary pad use, disposal, and menstrual health diseases. Fifth, the reactivation or linking of SHGs, as well as the administration of skill development programmes, to make them self-sufficient and financially secure.

OBJECTIVES OF THE STUDY

The study aimed to:

- Analyze the quality of environmental awareness in terms of cleanliness and sanitation in Mewat Region, Haryana.
- Eradicate the misconception / taboos & stigmas associated with not using toilets and following hygienic habits.
- Bring about awareness in society through various means like folk songs pamphlet distribution advertising vehicles creating and distributing appropriate information.
- Bring behavioral change among beneficiaries.

STUDY AND SAMPLING AREA

Mewat is known as the "land of Meos". This region is amongst the most backward regions of Haryana. A new district known as Mewat (Nuh) came into existence comprising five blocks namely Nuh, Taoru, Nagina, Punhana and Ferozpur Jhirka. The people in Mewat live in most deprived conditions of ignorance and poverty, completely unaware of their potential and individuality. Mewat remained a region of backwardness even after independence (Aspirational Districts Baseline Ranking, March2018, NITI Ayog). Despite of being very near to the capital of the country, it lags in almost each and every stream of development. The people are not conscious about the development programs sponsored by Central and State Governments. Most of the people are still living below poverty line and their education level is very low. Women are the main sufferers in this region. It has the highest percentage of women and children with anemia and lowest percentage of births that were assisted by a health professional (Maninder, et al, 2019) National Family Health Survey (NFHS, 2015-16) indicates the district to be low on every parameter. The Government is very keen to bring socio-economic development in the area by implementing various schemes and development programs for their development. In the year 1980, government of Haryana with a commitment to deliver social and economic justice to the backward and under-privileged sections of the society constituted. Mewat Development Board and implemented various development activities in Mewat area in the fields of health, Education, agriculture, irrigation, Animal Husbandry, Rural Water supply, Community Development and Industrial Development etc.

METHODOLOGY

As Mewat area consists of several villages we selected one village at a time. The various tools and techniques used in the study include (a) Open ended questionnaire (b) Community meetings (c) Focus group discussions and (d) Non-participant observation. The first step was to arrange a community gathering called PLA (Participatory Learning Appraisal) which help in the strategy formulation as per the experiences of the community and issues of the area. It involves main stakeholders including sarpanch of Gram Panchayat, Aanganwadi workers, Asha workers, active women group appraising him or her about the objective of the project for greater community participation. The second step was in the form of a door to door just to build the rapport with community for better and deep understanding of the problem and to find out the solutions. Some awareness campaigns and focus group discussions were also organized as the third step, to enter the area and for better outreach. This was for disseminating the knowledge about maintaining the good personal hygiene (Figure 1). Distribution of sanitary pads and IEC materials to women of reproductive age, as well as advice on how to use sanitary pads effectively. This whole segment was a part of menstruation hygiene management and training. The fourth phase is to revive or link SHGs and execute a skills development programme to help them become self-sufficient and financially stable.

Figure 1: Awareness and Community meetings held with people in the Nizampur Village, Mewat Area.

Our efforts for bringing about environmental awareness were done using the following methods.

- Organizing community meetings including sarpanch of the village, aanganwadi workers and other front-line workers.
- Behavioral change campaigns once in a week.
- Organizing workshops and seminars for school-aged children at their school to disseminate knowledge and skills related to excellent personal hygiene.
- Spreading awareness among adolescent and menstruating women girls about their menstrual hygiene, management of neat and clean surroundings through school sanitation clubs.
- Distribution of low-cost sanitary pads and IEC (Information. Education and communication) material amongst women of the reproductive age.
- Reaching out to SHGs (Self Help Groups) and conducting skill development programmes to make them self-dependent socially and financially.

RESULTS AND DISCUSSION

The present research deals with awareness pertaining to cleanliness and sanitation among the people of Mewat region in Haryana. In this study we organized some awareness programmes to have a greater reach and impact. During the visits we found lack of proper sanitation, infrastructure, and hygienic usage in many of the villages. The community is

riddled with a variety of myths and preconceptions. Our findings indicate a positive correlation between the ignorance, open defecation, and lack of awareness. Several awareness programs have been designed aiming to change the behavior of people.

(A) Open defecation

We visited the village and conducted the preliminary analysis as per our methodology mentioned above. The outcome of the study reveals that despite efforts made by Government and some other Non-Governmental Organizations (NGOs)and Civil Society that are active in the locality, few people still defecate in open and live in unhygienic conditions. It might be due to some loopholes and lacunas in the implementation part of the project. We found that 75% of the total households have access to sanitary infrastructure such as IHHTs (Individual Household Toilets) and bathrooms. However, the percentage of people using these is low. We observed the following reasons for lower usage of sanitary infrastructure.

- Some people do not have the access to the toilets due to some financial constraints.
- Some of them have access to toilets but still do not use them as they are using it for some other purpose like storing fodder for cattle, poultry, or agricultural produces.
- Some of them were using it in the past but recently stopped as the structure of the IHHTS are no longer functional and intact.
- In few houses, we found that menstruating females were prohibited to use the toilets during those days.
- Few among the respondent told that they did not use it due to some mythological reasons.
- Male populace of the locality felt that the closed environment of a toilet was not suitable for defecation.
- Some of them gave the reason that they are not using the toilets because of unavailability of water and quoted "*Toilet needs a lot of water for their maintenance and flushing. We have shortage of water and that is why we use it less frequently"*.
- Lastly, there is deep rooted misconception and lack of awareness among the rural masses regarding use and maintenance of toilets.

(B) MHM (Menstruation Hygiene Management)

We observed that, toilet facilities proved as a boon for adolescent girls and women. In villages they lack privacy and failed to manage their menstruation well. Unhygienic menstruation management leads to diseases and infection that may ultimately lead to loss of life. Sclar et al. (2018) in their study report the relationship of sanitation, social and mental well-being among people. They explain that People's mental and social well-being can be significantly impacted when they believe or experience a lack of privacy or safety while defecating openly or utilizing sanitary facilities (Sclar et al. 2018). One of the larger determinants of not constructing toilets in villages is related to power dynamics in the family associated with patriarchy. We find similar observations in our study too. Female respondents emphasized about the need for and importance of a functional toilet. One among them told us that they are being forbidden from using toilets during menstruation period. When women requested for toilet facilities in their home, their male counterparts bring up the notion of tradition and culture. In this locality decision making solely rests with the male members as they are the head of the family. They did not involve women in any kind of decision-making. Prevalence of such behaviors might be due to the lack of awareness and perception among rural masses.

There are many small NGOs already working in Mewat. They have focused on various issues like sanitation, education, health and other sectors but something still seems to be missing. Our findings are in line with other authors. Despite the presence of family toilets, open defecation is frequent in Tamil Nadu's Dharmapuri district(Yogananth et al. 2018).Several structural and socio-cultural factors influence toilet usage. According to a study undertaken by Yogananth et al. (2018) the mission must shift its focus from toilet construction to toilet operation and use. According to a study by Saleem et al. (2019), diseases related to unsafe water, poor sanitation, and lack of hygiene are some of the most common causes of illness and death among the poor of developing countries. Whereas a study conducted by Michael et al. (2020) in Quetta, Pakistan concluded that female adolescents had certain misconceptions regarding menstruation because of poor access to health-related education. These misconceptions hamper the issues related to menstruation hygiene management it. Menstruating women and girls are said to be stigmatized in many cultures, as they are seen as filthy, polluted, and polluting (Wendland et al. 2017).Most girls and women have significant practical issues regulating their menstruation because of the low priority of menstrual hygiene from policymaking to family financial decisions. Poor households, especially those without dependable access to essential services, bear the brunt of the negative effects of water-related sickness. Saleem et al. (2019) found that women and girls' health and social requirements are largely unmet, and that they are frequently ignored in situations where there are no toilets in the home. Further, due to natural limitations such as physical distance and unsafe latrines, social concerns, and worries of sexual violence, poor sanitation causes emotional stress among women and girls (Sahoo et al. 2018). These are in consensus with our studies.

LIMITATIONS

When it comes to campaign and awareness programme limits, there are numerous loopholes and flaws that existed at various stages of programme creation and execution. The following are a few of them:

- The people in rural regions are rigid and set in their beliefs, thoughts, and conduct and they don't easily accept change.

- In terms of sanitation, many villages have been provided with toilet facilities, but they do not want to take ownership and responsibility.
- There are some SHGs operating in the village, but they are not in a structured form, and these SHGs are unable to work properly due to internal conflicts among their members.

RECOMMENDATIONS

There is no doubt that some work has been done for awareness generation among the masses through this study. However, if the anticipated outcomes are not displayed as expected, there may be a problem. From our perspective, there are some suggestions for improving the situation. As we have observed, there is a direct link between ignorance or a lack of awareness and open defecation. We can spread awareness through the following methods.

- Folk songs Nukkad-natak folk dance in their local language.
- Pamphlet distribution, advertising vehicles creating and distributing appropriate information education and communication material to targeted beneficiaries.
- Conducting behavior change programs.
- Social stigma redressal.
- Personality development programs.
- Financial literacy program.
- Making sanitation clubs in schools for girls may prove effective as many girls are not able to aware their families about sanitation, as girls and women play passive roles in their family.
- These awareness programs need to be organized periodically at each front.
- Programs need to be inclusive.
- Language of the IEC (Information, Education and Communication) material should be lucid and catchy.

CONCLUSION

Because raising awareness is a collaborative effort, it requires active participation from all community stakeholders for the project to be effective. Meanwhile, the genuine beneficiaries are adolescent girls, children, mothers, and the elderly. Changes in behaviour and perception, environmental cleanliness, lower disease infection rates, reduced societal stigmas and taboos, lower school dropout rates, and effective menstrual hygiene management are all markers of the outcomes. In a nutshell, we can say that successful environmental awareness programme execution requires robust community participation.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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GROUNDWATER QUALITY ASSESSMENT FOR DRINKING PURPOSE IN BALTANA AREA OF ZIRAKPUR, PUNJAB AND SECTOR-19, PANCHKULA CITY, HARYANA, INDIA

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Abstract
Water is important for survival of living beings on the Earth. Developmental activities have put pressure on the availability and quality of water resources especially on groundwater. The present study has been carried out in Baltana area of Zirakpur of Mohali district, Punjab and Sector-19 of Panchkula city, Haryana. Four groundwater samples have been collected in the month of June 2019 from different locations in the study area. Geo-coordinates of groundwater samples were noted using mobile GPS. Chemical analysis of groundwater samples were done using field water testing kit prepared by Tamilnadu Water Supply and Drainage Board, Chennai for ten chemical parameters-pH, hardness, chloride, fluoride, iron, ammonia, nitrite, nitrate, phosphate and residual chlorine. pH is 7,5 in all the four groundwater samples, hardness ranges from 150 mg/l to 350 mg/l, chloride ranges from 50 mg/l to 270mg/l, fluoride ranges from 0.5 mg/l to 1 mg/l, iron ranges from 0.3mg/l to 2 mg/l,ammonia ranges from 0 mg/l to 3 mg/l,nitrite ranges from 0.2 mg/l to 1 mg/l,nitrate ranges from 20 mg/l to 100 mg/l, phosphate ranges from 0.5 mg/l to 1 mg/l,residual chlorine ranges from 0 mg/l to 0.2 mg/l. Overall groundwater quality at all the four groundwater sample locations i.e. Tribune Colony, Baltana (non-potable iron and ammonia), Saini Vihar, Baltana (non-potable nitrate), Vaishali Enclave, Baltana (non-potable iron), Sector-19, Panchkula (non-potable iron and nitrate) is non-potable. The data of the study can be used for monitoring groundwater quality for drinking purpose in the study area.

Keywords
Groundwater, quality, drinking, Baltana, Zirakpur, Panchkula.

INTRODUCTION

Water is important for survival of all the living beings on the Earth. The present developmental activities have put stress on water quantity and quality. Though water quantity and quality play vital role in the existence of living beings and infrastructure but the role of good quality water is more than quantity of water. In urban areas groundwater is deteriorated due to anthropogenic pollution sources like household sewage waste and industrial waste disposals. Prakash and Somashekar (2006), Deshpande and Aher (2012), Rao et al. (2013), Alhaba by et al. (2015), Annapoorna and Janardhana (2015), Spanos et al. (2015), Srinivas et al. (2015), Madhav et al. (2018), Siddiqui et al. (2018), Hanumantharao, et al. (2019) have studied groundwater quality in urban areas.

STUDY AREA

The study area Baltana is a part of Zirakpur in Mohali district, Punjab and Sector-19 of Panchkula city in Haryana. Baltana is located at a distance of 2.7 kms from Chandigarh connected by the Zirakpur Panchkula-Kalka highway NH-5. The study area is falling between the latitude30°40'50.62"N to 30°40'6.91"N and longitude76°49'18.18"E to 76.50'5.61"Eand covers an area of 9.649Km^2 (Fig 1). Baltana has changed from agriculture sector to residential and industrial sectors.

OBJECTIVE

The main objective was to assess groundwater quality for drinking purpose in the study area.

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MATERIALS USED AND METHODOLOGY

In the study area four groundwater samples were collected during field visit in the month of June 2019 from tube wells in plastic 250 ml bottles. Geo-coordinates of the sample locations were noted using mobile GPS (Table 1). Chemical analysis of groundwater samples was done using Field Water Testing kit prepared by Tamilnadu Water Supply and Drainage Board (TAWD), Chennai for ten chemical parameters viz. pH, hardness, chloride, fluoride, iron, ammonia, nitrite, nitrate, phosphate and residual chlorine (Table 2). Results of groundwater samples analysis were categorized as desirable, permissible and non-potable on the basis of BIS (IS: 10500:2012) drinking water standards (Table 3).

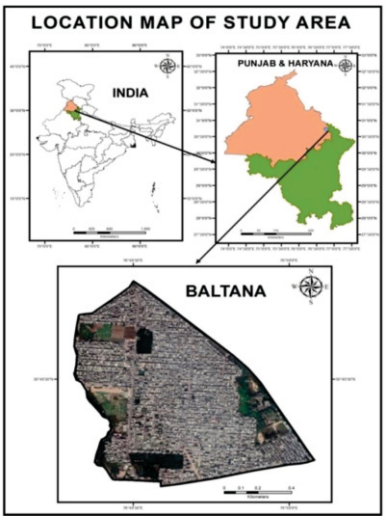

Fig.1: Location map of the study area.

Table 1: Groundwater sample locations in the Study Area.

S. No.	Sample Location	Source	Latitude	Longitude
1	Vaishali Enclave, Baltana	Tube Well	30.6796450	76.8245980
2	SainiVihar, Baltana	Tube Well	30.6782630	76.8278850
3	Sector 19, Panchkula	Tube Well	30.6713780	76.8321880
4	Tribune Colony, Baltana	Tube Well	30.6716930	76.8259920

Table 2: Results of groundwater samples analysis.

S. No.	Location	pH	Hardness (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Iron (mg/l)	Ammonia (mg/l)	Nitrite (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Residual Chlorine (mg/l)
1.	Tribune Colony, Baltan	7.5	320	160	1	2	3	0.2	45	1	0
2.	Saini Vihar, Baltana	7.5	200	50	1	0.3	0.5	0.2	100	0.5	0.2
3.	Vaishali Enclave, Baltana	7.5	300	270	1	2	0	0.2	20	0.5	0
4.	Sector-19, Panchkula	7.5	150	50	0.5	2	0.5	1	100	0.5	0.2

Table 3: BIS Drinking Water Standards (IS 10500:2012).

S. No.	Constituent	Potable		Non-Potable
		Desirable	Permissible	
1	pH	6.5 to 8.5	-	<6.5 to >8.5
2	Total Hardness (mg/l)	<200	200-600	>600
3	Chloride (mg/l)	<250	250-1000	>1000
4	Fluoride (mg/l)	<1.0	1.0-1.5	>1.5
5	Iron (mg/l)	<0.3	-	>0.3
6	Ammonia (mg/l)	<0.5	-	>0.5
7	Nitrite (mg/l)	<1.0	-	>1.0
8	Nitrate (mg/l)	<45	-	>45
9	Phosphate (mg/l)	<1.0	-	>1.0
10	Residual Chlorine (mg/l)	<0.2	0.2-1	>1.0

RESULTS AND DISCUSSION

I. pH

In the study area, pH in all the four groundwater samples (Tribune Colony, Baltana, SainiVihar, Baltana, Vaishali Enclave, Baltana, Sector-19,Panchkula) is 7.5 which falls under desirable category of BIS (IS 10500:2012) drinking water standards (Fig.2).

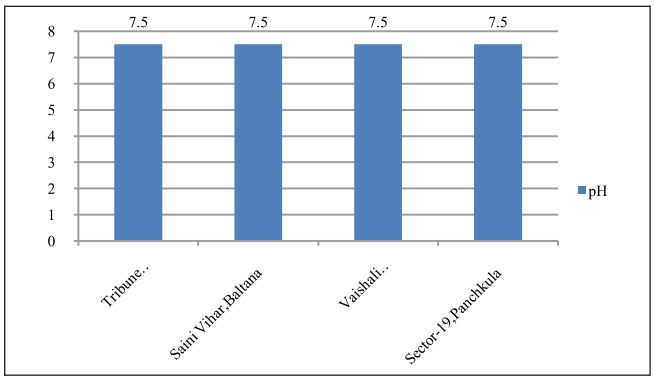

Fig.2: pH in groundwater samples.

ii. Hardness

In the study area, hardness ranges from 150 mg/l to 350 mg/l. Hardness in groundwater samples at Saini Vihar, Baltana (200 mg/l) and Sector-19, Baltana (150mg/l) is desirable while permissible at Tribune Colony, Baltana (320 mg/l) and Vaishali Enclave, Baltana (300 mg/l) (Fig.3).

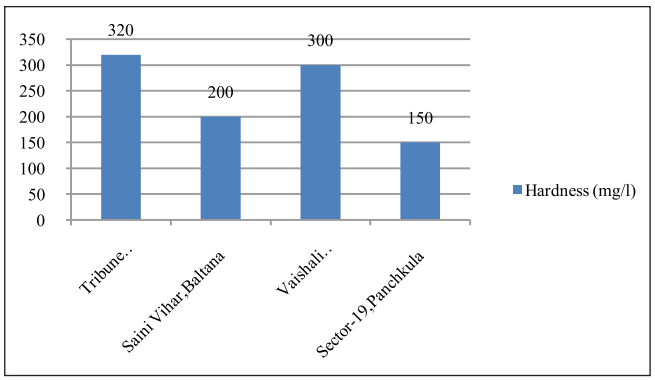

Fig. 3: Hardness in groundwater samples.

iii. Chloride

In the study area, chloride ranges from 50 mg/l to 270mg/l. Chloride is desirable in groundwater samples at Tribune Colony, Baltana (160mg/l), Saini Vihar, Baltana (50mg/l), Sector-19,Panchkula (50mg/l) and permissible at Vaishali Enclave, Baltana (270 mg/l) (Fig.4).

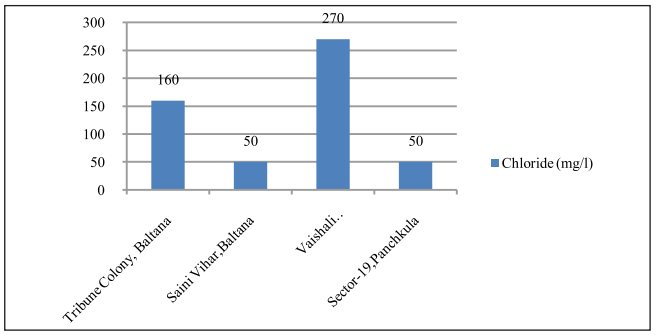

Fig. 4: Chloride in groundwater samples.

iv. Fluoride

In the study area, fluoride ranges from 0.5 mg/l to 1 mg/l. Fluoride is desirable in all the four groundwater samples-Tribune Colony, Baltana (1 mg/l), Saini Vihar, Baltana (1 mg/l),Vaishali Enclave, Baltana (1 mg/l),Sector-19, Panchkula (0.5 mg/l) (Fig.5).

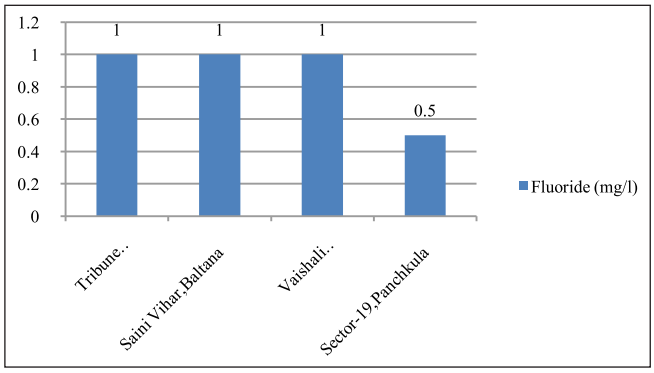

Fig. 5: Fluoride in groundwater samples.

v. Iron

In the study area, iron ranges from 0.3 mg/l to 2 mg/l. Iron is desirable in groundwater sample at Saini Vihar, Baltana (0.3 mg/l) and non-potable at Tribune Colony, Baltana (2 mg/l), Vaishali Enclave, Baltana (2 mg/l), Sector-19, Panchkula (2 mg/l) (Fig.6).

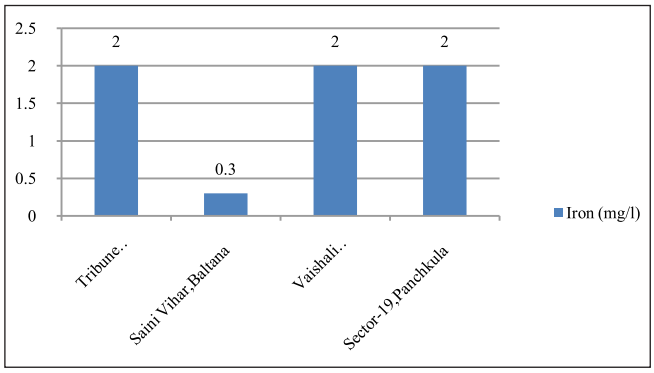

Fig. 6: Iron in groundwater samples.

vi. Ammonia

In the study area, ammonia ranges from 0 mg/l to 3 mg/l. Ammonia is desirable in groundwater samples at Saini Vihar, Baltana (0.5 mg/l), Vaishali Enclave, Baltana (0 mg/l), Sector-19, Baltana (0.5 mg/l) and non-potable at Tribune Colony, Baltana (3 mg/l) (Fig.7).

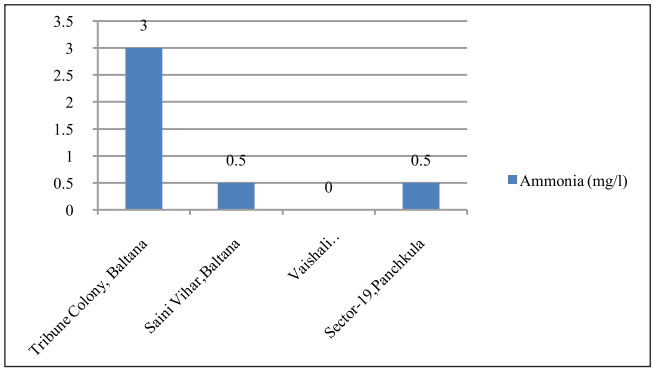

Fig.7: Ammonia in groundwater samples.

vii. Nitrite

In the study area, nitrite ranges from 0.2 mg/l to 1 mg/l. Nitrite is desirable in all the four groundwater samples (Tribune Colony, Baltana (0.2 mg/l), Saini Vihar, Baltana (0.2 mg/l), Vaishali Enclave, Baltana (0.2 mg/l), Sector-19,Baltana (1 mg/l) (Fig.8).

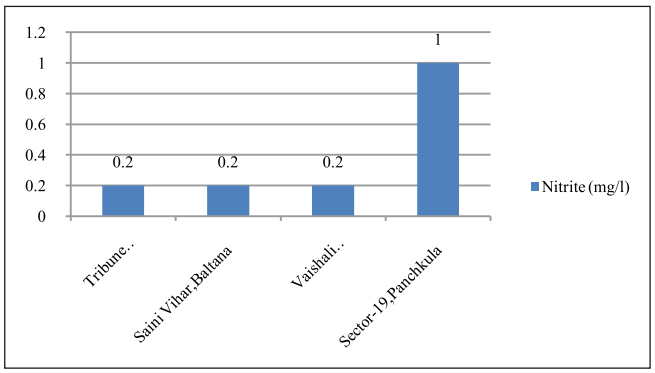

Fig. 8: Nitrite in groundwater samples.

viii. Nitrate

Nitrate ranges from 20 mg/l to 100 mg/l in the study area. Nitrate is desirable in groundwater samples at Tribune Colony, Baltana (45 mg/l) and Vaishali Enclave, Baltana (20 mg/l) and non-potable at Saini Vihar, Baltana (100 mg/l) and Sector-19, Panchkula (100 mg/l) (Fig.9).

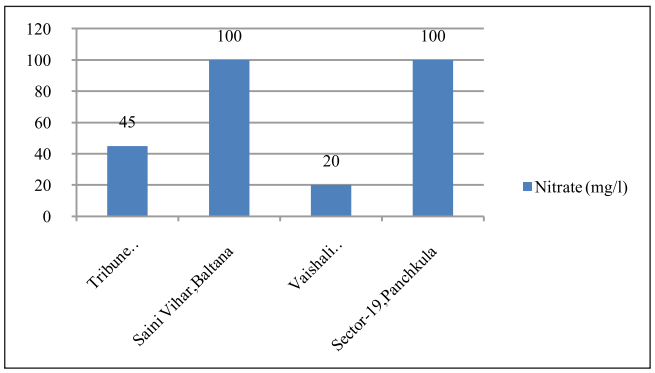

Fig. 9: Nitrate in groundwater samples.

ix. Phosphate

In the study area, phosphate ranges from 0.5 mg/l to 1 mg/l. Phosphate is desirable for drinking purpose in all the four groundwater samples (Tribune Colony, Baltana (1 mg/l), Saini Vihar, Baltana (0.5 mg/l), Vaishali Enclave, Baltana (0.5 mg/l) and Sector-19,Baltana (0.5 mg/l) (Fig.10).

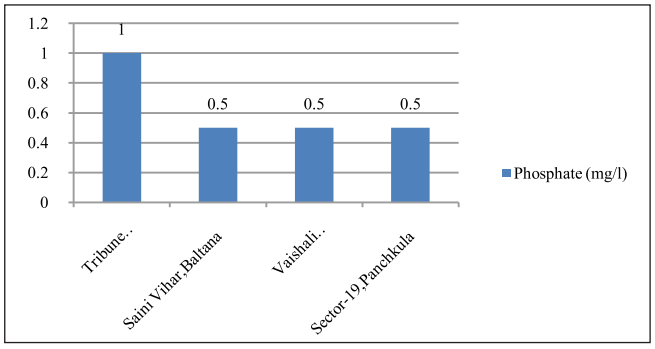

Fig. 10: Phosphate in groundwater samples.

x. Residual Chlorine

In the study area, residual chlorine ranges from 0 mg/l to 0.2 mg/l. In all the four groundwater samples residual chlorine is desirable as per BIS (IS 10500:2012) drinking water standards (Tribune Colony, Baltana 0 mg/l, Saini Vihar, Baltana 0.2 mg/l, Vaishali Enclave, Baltana 0 mg/l, Sector-19, Baltana 0.2 mg/l) (11).

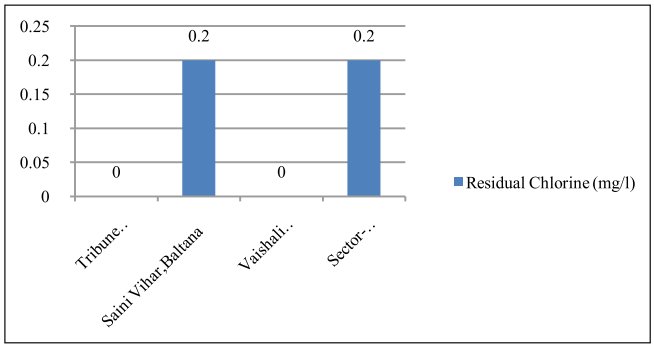

Fig. 11: Residual Chlorine in groundwater samples.

GROUNDWATER QUALITY AT SAMPLE SITES

i. Tribune Colony, Baltana

Tribune Colony, Baltana groundwater sample have pH, chloride, fluoride, nitrite, nitrate, phosphate, residual chlorine are desirable; hardness is permissible; iron, ammonia are non-potable, hence, groundwater is non-potable (Fig.12).

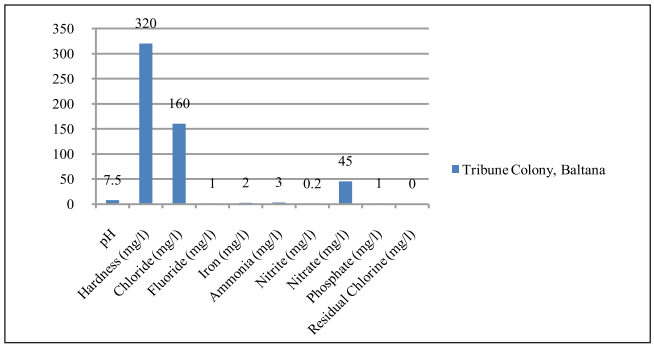

Fig.12: Groundwater quality at Tribune Colony, Baltana.

ii. Saini Vihar, Baltana

Saini Vihar, Baltana groundwater sample have pH, hardness, chloride, fluoride, iron, ammonia, nitrite, phosphate, residual chlorine are desirable and nitrate is non-potable, hence, groundwater is non-potable (13).

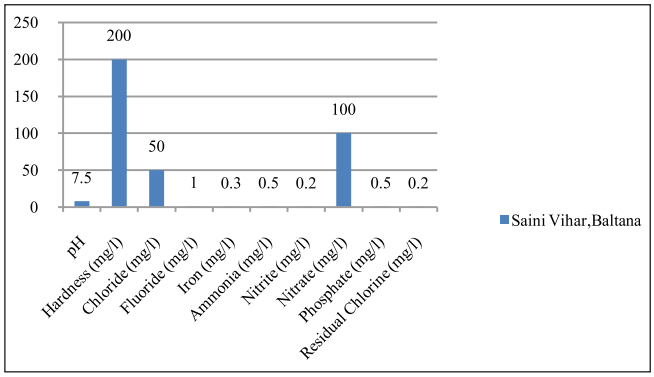

Fig. 12: Groundwater quality at Tribune Colony, Baltana.

iii. Vaishali Enclave, Baltana

Vaishali Enclave, Baltana groundwater sample have pH, fluoride, ammonia, nitrite, nitrate, phosphate, residual chlorine are desirable; hardness, chloride are permissible and iron is non-potable, hence, groundwater is non-potable (Fig.14).

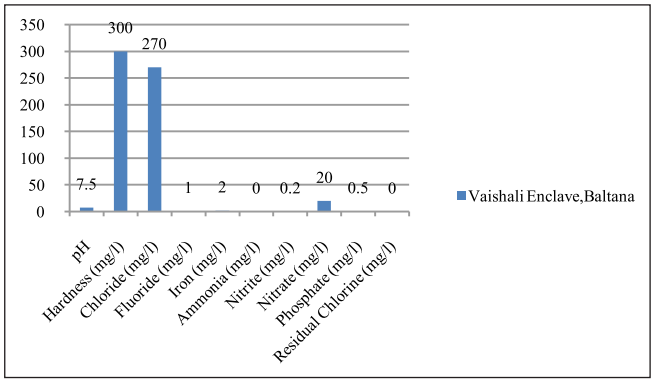

Fig. 14: Groundwater quality at Vaishali Enclave, Baltana.

iv. Sector-19, Panchkula

Sector-19, Panchkula groundwater sample have pH, hardness, chloride, fluoride, ammonia, nitrite, phosphate, residual chlorine are desirable and iron, nitrate are non-potable, hence, groundwater is non-potable (Fig.15).

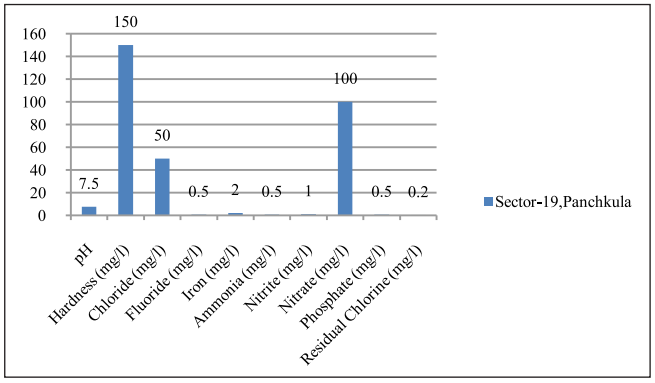

Fig. 15: Groundwater quality at Sector-19, Panchkula.

CONCLUSIONS

In the study area pH, fluoride, nitrite, phosphate, residual chlorine are desirable in all the four groundwater samples. Hardness is desirable at SainiVihar (200 mg/l) and Sector-19 (150 mg/l) while permissible at Tribune Colony (320 mg/l) and Vaishali Enclave (300 mg/l). Chloride is desirable at Tribune Colony (160 mg/l), SainiVihar (50 mg/l), Sector-19 (50 mg/l) and permissible at Vaishali Enclave (270 mg/l). Iron is desirable at Saini Vihar (0.3 mg/l) and non-potable at Tribune Colony (2 mg/l), Vaishali Enclave (2 mg/l), Sector-19 (2 mg/l). Ammonia is desirable at Saini Vihar (0.5mg/l), Vaishali Enclave (0 mg/l), Sector-19 (0.5 mg/l) and non-potable at Tribune Colony (3 mg/l). Nitrate is desirable at Tribune Colony (45 mg/l) and Vaishali Enclave (20 mg/l) and non-potable at Saini Vihar (100 mg/l) and Sector-19 (100 mg/l). Groundwater quality at all the four groundwater sample locations i.e. Tribune Colony, Baltana (non-potable iron and ammonia), Saini Vihar, Baltana (non-potable nitrate),Vaishali Enclave, Baltana (non-potable iron), Sector-19, Panchkula (non-potable iron and nitrate) is non-potable. The study is highly useful for monitoring groundwater quality for drinking purpose in the study area.

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A STUDY OF THE JHELUM RIVER'S WATER QUALITY

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Abstract
The current research focuses on the quality of the Jhelum River, which flows through Srinagar in Kashmir, India. Over the course of eight months (April to November 2021), water samples from various points along the river were collected and tested to assess the water quality based on several factors such as turbidity, taste and odour, total hardness, arsenic, nitrate, sulphate, fluoride, iron, pH, and biological parameters. 7.7 was the highest pH value ever recorded. The lowest turbidity found was 0.9, while the maximum turbidity found was 19.7. The waters had a hardness of 250 mg/l and 375 mg/l, respectively. In majority of the criteria, the water at the site where the wastes were released into the river was found to be more contaminated than the water at the other sites. Almost all the parameters were within the permissible limits except for biological contamination. The focused group discussion and interaction with locals showed an indication of people's knowledge, attitudes, and awareness about water quality, cleanliness, and contamination in the Kashmir Valley. Environmental awareness is the most effective strategy for bringing about societal change for environmental health. Therefore, some awareness programmess were conducted based on the focused group discussions held.

Some awareness programmes were held on a regular basis in the village in question. Further research reveals a shift in community behaviour. Because the process of raising awareness is inclusive, it engages people from all walks of life. Meanwhile, adolescent girls, children, mothers, and the elderly are the true beneficiaries. Changes in behaviour, cleanliness of the environment (environment), lower disease transmission rates, reduced social stigmas and taboos, lower school dropout rates, and effective menstrual hygiene management are all examples of the effects. In a word, we can state that successful implementation of environmental awareness programmes requires active community participation.

Keywords
Jhelum River, Contamination, Kashmir, Water quality.

INTRODUCTION

Water is essential to all living beings and is a significant natural resource. In the past, the water quality in Jammu & Kashmir was practically perfect and devoid of pollution. As a result of anthropogenic activity, the water is now potentially dangerous to human consumption and health. Surface and ground water in the valley have recently been subjected to frequent pollution because of industrial and agricultural activity. Apart from that, residential trash generated by a big population, particularly in places like Srinagar, causes significant environmental and water resource harm. Sewage organics and nutrients combine with water bodies, resulting

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in microbial infestation. Pathogenic disease-causing organisms are important in terms of health since they can cause a variety of diseases if they are not adequately treated. As a result of environmental and human health problems, water quality monitoring is becoming increasingly important (Ali et al., 2007).

Several researchers have observed that industrial, household, and agricultural activity in India have polluted several water basins (Subramanyam, 2006 and Sathware et al., 2007). 80 percent of infections like cholera, amoebiasis, typhoid fever, and giardiasis are caused by contaminated water (WHO, 1997). Several researchers have reported on river pollution's water quality and its effects on human health (Biggs, 1995; Gergel et al., 1999; Caraco et al., 2003; Donohue et al., 2006).The Jhelum River is Kashmir's largest and most important source of water. In Kashmir, the water body provides a major source of electricity, irrigation, and drinking water.It comes from Verinag Spring, which is located at the foot of the Pir Panjal in the Kashmir Valley's southeastern corner. Lidder nallah near hamlet Mirgund at Khanabal, river Veshaw at Sangam in Anantnag, and Sind River at Shadipora in Kashmir Valley are its tributaries. The Kashmir valley has seen a rise in construction activities and vehicular movements during the last decade. The river Jhelum's water quality has deteriorated due to increased population, agricultural activities, and garbage from residential and floating vegetable markets in the valley, rendering it unsafe for human consumption. Pathogens, harmful metals, chemical compounds such as pesticides, herbicides, fertilisers, and other commercial operations and industrial waste can all pollute drinking water. The water is used for irrigation, drinking, and other domestic purposes by the people who live downstream. Furthermore, marketplaces have been shown to be a major source of water pollution. Most plastic products, polythene bags, garbage, and other items come from marketplaces and are then thrown directly or indirectly into rivers or water bodies, causing pollution.

The purpose of this study was to examine certain key water characteristics for the river Jhelum. Turbidity, pH, Fluoride, Iron, Nitrate, Sulphate, Hardness, Alkalinity, Chloride, and *E. coli* were among the physico-chemical and biological characteristics studied.

OBJECTIVES

The objectives of the study were the following.

- To analyse the quality of water at various points of river Jhelum.
- To identify the reasons for the difference in the parameters.
- Based on the study results recommendations or suggestions for improvement in the water quality will be given.

METHODOLOGY

Sample collection

Water samples were taken from the Jhelum River at various locations including Verinag (source), Anatnag, Padgampora, Larkipora, Awantipora, Barsoo, and Srinagar (Table 1, Figure 1). I chose these locations for sampling because Verinag is the source of the Jhelum River and is away from from human settlements, whereas the other sites are heavily populated and have a greater impact on the water quality. Other locations have become contaminated because of increased drainage systems that flow directly or indirectly into the river, but Verinag is free of contamination. Field test kits were used to analyse samples from all the sites on the spot. The samples were collected using the grab sampling method. All samples were collected in 1.5 litre sterile polyethylene bottles, transported to the lab, and processed within 1-2 days.

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Table 1: Location of sampling sites.

S. No	Name of Location and Sampling points	Location Code	Latitude	Longitude
01	Verinag	A	33°32’5”	75°14’8”
02	Anantnag	B	33°43’47”	75°8’59”
03	Padgampora	C	33°55’25”	75°0’37”
04	Larkipora	D	33°54’3”	75°0’45”
05	Awantipora	E	33°55’37”	75°0’6”
06	Barsoo	F	33°57’5”	74°58’57”
07	Srinagar	G	34°5’1”	74°47’5”

Figure 1:Map showing different areas of sampling

(A) Sample taken from Vering source
(B) Sample taken from Anatnag district
(C) Sample taken from Padgampora of district Pulwama few kilometers away from Srinagar-Jammu national highway
(D) Sample taken from Larkipora Awantipora a nearby village to Awantipora
(E) Sample taken from Awantipora town located in the middle of Srinagar and Anantnag
(F) Sample taken from Barsoo near national highway.
(G) Sample taken from Srinagar city near Rajbag Srinagar**.**
(H) Awantipoa near Jamia Masjid

Physiochemical and Biological analysis

The samples were collected over the course of eight months, from April 2021 to November 2021 (Figure 2). Standard methods were used to investigate the physiochemical and biological parameters such as Turbidity, pH, Fluoride, Iron, Nitrate, Sulphate, Hardness, Alkalinity, Chloride, E. coli, Turbidity, pH, Fluoride, Iron, Nitrate, Sulphate, Hardness, Alkalinity, Chloride, and *E. coli*. Standard methods such as APHA (2017) and BIS (2012) were used in the analysis. Field Test Kits were utilised for on-the-spot examination, and additional methods included photospectrometric methods, turbidity and pH were measured using electrometric methods (Figure 2).As a result, the results were obtained using either digital metres or the colour comparison approach.

Figure 2: Sample collection at various points and onspot analysis.

Focussed Group Discussion

Focussed Group discussion was carried out among the population in these areas to assess the knowledge, attitude, and awareness of the water quality and contamination prevailing in their area. We also explored the degree of public satisfaction with drinking water quality, public trust of drinking water safety, and public awareness about drinking water problems and solutions.

RESULTS AND DISCUSSION

Water testing is necessary for monitoring water supply operations, ensuring the safety of drinking water, investigating disease outbreaks, validating processes, and implementing preventive measures. To determine the safety of drinking water, water quality testing techniques must be utilised at the source, within a piped distribution system, or at the end user. Water quality surveillance and drinking water quality monitoring are two separate but connected activities.

The Jhelum River, which originates from the famous spring Verinag, is the main supply of water in the Kashmir valley. The river Jhelum is polluted by drainage systems from locals, agricultural runoff, and wastewater discharges from numerous small and large-scale industrial facilities because it passes through several places across the valley starting from Verinag. The River Jhelum was studied, and seven sampling locations were chosen at random, beginning in Verinagupto Srinagar. The samples were examined and compared to the permitted limit defined by the IS: 2296 and the Central Pollution Control Board (CPCB). Table 2 lists the numerous physio-chemical and biological parameters that were examined at these locations, as well as the complete results.

A lot of waste is thrown near the riverbanks by tourists, people living near these areas which is a cause of concern. Figure 3 shows the various forms of waste materials, including polythene bags, organic wastes arriving from adjacent villages and marketplaces. These wastes are accumulated and form waste piles near the river Jhelum banks at all points except Verinag, resulting in soil and river contamination.

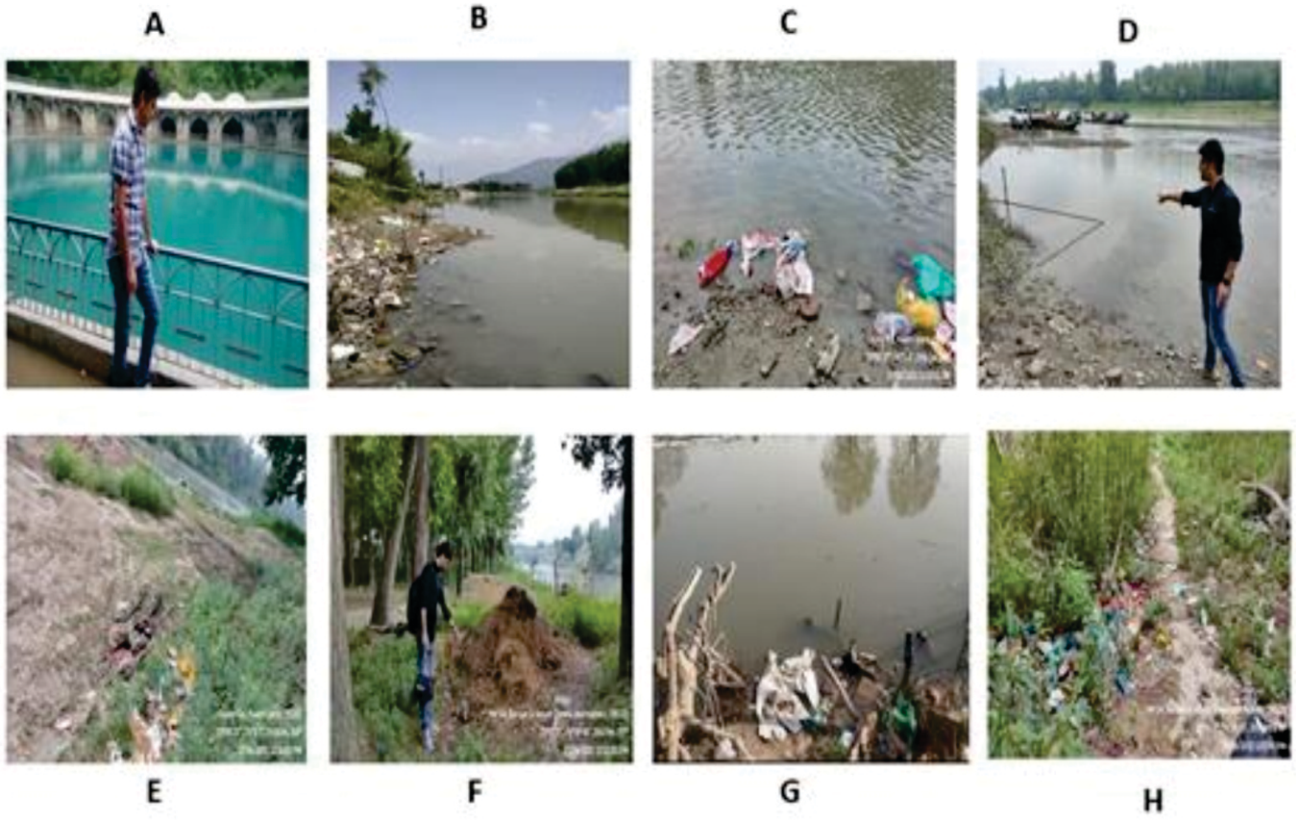

Figure 3: Waste Materials thrown around the riverbanks.

A. Vering source free from any contamination with clean pure water.

B. Wastes accumulated at various areas around river Jhelum at Anatnag district

C. Padgampora of district Pulwama. Organic wastes coming from nearby areas resulting in bacteriological contamination

D. Larkipora Awantipora a nearby village to Awantipora.

E. Awantipora town located in the middle of Srinagar and Anantnag

F. Barsoo near national highway.

G. Srinagar city near Rajbag Srinagar.

H. Awantipoa near Jamia Masjid

Table 2: Physio-chemical and biological parameters analysed at various sampling points along river Jhelum.

District				Anatnag	Anatnag	Pulwama	Pulwama	Pulwama	Pulwama	Srinagar
SOURCE				River	River	River	River	River	River	River
Status-Raw/Treated water				Raw water	Raw water	Raw water	Raw water	Raw water	Raw water	Raw water
Place of collection				Verinag	Anatnag	Padgampora	Larkipora	Awantipora	Barsoo	Srinagar
Sl. No.	**Parameters**	**Units**	**Desirable\ Permissible limits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Iron	mg/l	0.3 - 1.0	0	0	0	0	0	0	0
2.	Nitrate	mg/l	0 - 45	30	40	40	40	45	40	40
3.	Total Arsenic	mg/l	0.1 – 0.10	0	0	0	0	0	0	0
4.	Fluoride	mg/l	1.0 - 1.5	0	0	0.2	0.1	0.2	0.3	0.2
5.	Total Alkalinity	mg/l	200 - 600	220	260	300	300	320	340	340
6.	Residual Chlorine	mg/l	0.2 - 1.0	Raw water	Raw water	Raw water	Raw water	Raw water	Raw water	Raw water
7.	Sulphate	mg/l	200-400	200	210	240	250	260	260	270
8.	pH @ ^{o}C	-	6.5-8.5	7.6	7.7	7.3	7.5	7.6	7.4	7.5
9.	Turbidity	N.T. U	1.0-5.0	0.9	9.8	12.1	12.6	13.1	15.9	19.7
10.	Total Hardness	mg/l	200-600	250	300	325	350	350	360	375
11.	Total Coliform	MPN	Zero	ND	Detected	Detected	Detected	Detected	Detected	Detected
12.	Taste and Odour	-	Unobjectio-nable	UO	UO	UO	UO	UO	UO	UO

i. pH

According to water quality standards, the pH limits should be 6.0 - 8.5. The pH values for all the samples were almost uniform at all points except at certain places it is alkaline. The pH of all the samples was found to be within the BIS range of 6.5 to 8.5. Samples were mostly neutral. The pH from A to G points were normal. The pH limit for drinking water is 6.5 to 8.5. Majority of the samples most of the time showed less than a pH of 8 (Table 2). Similar results were reported by other researchers on the river Jhelum (Khan et al. 2012).Therefore, the pH fluctuated from 7.3 to 7.7. In rivers the occurrence and abundance of components of carbonate system and the pH are determined primarily by current and chemical nature of the substrate (Reid, 1961).Taste and Odour was unobjectionable at all points. Scientists have reported that municipal and domestic wastes can also change the pH of the water bodies (Sithik et al., 2009). The pH greatly affects the biogeochemistry in aquatic ecosystems, such as growth of fishes and aquatic plants. Because most of their metabolic activities are pH dependant, pH has an impact on aquatic species(Wang et al., 2009; Jehangir et al., 2011; Mushtaq et al., 2015).

ii. Turbidity

The samples were tested for their turbidity, and it was observed to be normal and within the permissible limits at Verinag. However, as we descend to Srinagar, it continues to rise. At point A it was below 1 NTU and it was above 5 NTU at points B, C, D, E, F and G but remains below 20 NTU at all points upto point G except A. At point A the turbidity was noted as (0.9), B (9.8), C(12.1),D (12.6), E(13.1), F (15.9), G (19.7) NTU. Hence, turbidity was above permissible limit at all points except Verinag (Table 2). The normal range of turbidity as per BIS is that it should not exceed 5NTU.The higher turbidity values indicate pollution and contamination of the waters (Figure 4).

iii. Flouride

Fluoride was also determined spectrophotometrically. Flourides in the water samples were present within permissible limits. It did not go above 0.5 at all points (Table 2). The permissible limit for fluoride is 0.5-1.5 mg/l as per BIS and WHO. Very low levels of fluorides can lead to deficiency and health effects such as dental caries (Schamschula and Barmes, 1981) and higher levels can lead to bone deformities and mottling of the teeth.

iv. Iron

Iron was also determined spectrophotometrically. Iron in the water samples was zero at all points (Table 2). Hence the water was free from iron content at all points of the study area. The permissible limit for iron is upto 1 mg/l as per BIS and WHO.

v. Hardness

Total hardness of all the samples was found to be within

permissible limit. Average total hardness of most of the samples in the study area was found to be higher than 200mg/l indicating that the water is hardwater (Table 2). Total hardness in most cases is always higher than 300mg/l which is the permissible limit by BIS as well as WHO standards. At point A, the value noted was 250mg/l and the highest value was seen at point G with 375mg/l (Table 2, Figure 4). Studies by other researchers such as Mir et al. (2012) reported that the total hardness of the river Jhelum fluctuated between the highest annual mean value of 150 ± 44.33 mg/l and 101±30.46 mg/l.

vi. Alkalinity

It is the capacity of water to neutralize acid. It is a measure of bicarbonates, carbonates and hydroxides present in water. Alkalinity was found to be within permissible limit (Table 2). Total alkalinity of all the samples was not higher than the permissible value (200mg/l and 600mg/l) suggested by BIS as well as WHO. At point A, the value noted was 200 mg/l. The highest values were observed at point G 340mg/l.Mir et al. (2012) reported alkalinity values at Jhelum River with highest annual mean value 150± 35.75 mg/l.

vii. Sulphate

The amount of sulphate was analysed through spectrophotometer as well as on spot using Field Test Kit Sulphate was found within the permissible limits at all sampling points. At point A, sulphate was observed as 200mg/l. The points at E, F and G recorded highest values of sulphate concentrations from 260 and 270 mg/l (Table 2, Figure 4). These higher values may be due to municipal waste effluents and agricultural run off. Qadri et al. (1981) and Shyam (1981) both reported similar results (1988). Researchers have also reported decrease in sulphate concentration during spring due to the metabolic reduction process mediated by sulphate reducing bacteria (Bellos et al., 2004).

viii. Nitrate

Nitrate was estimated using a UV-Visible Spectrophotometer. Nitrogen and phosphorus are important factors in an aquatic ecosystem and play a key role in the productivity of an aquatic habitat. Nitrates were present within the permissible limits at all points throughout the period of study. The maximum permissible limit of Nitrate is 45 mg/l. Almost all the samples had nitrate levels of nearly 40 mg/l.

ix. Arsenic

Arsenic was also determined spectrophotometrically. Arsenic in the water samples were zero at all points. Hence the water was free from any Arsenic content at all points of the study area. It did not go above 0 mg/l at all points. Therefore, there is no arsenic heavy metal pollution in any of the sampling the points tested.

x. Residual chlorine

The value of residual chlorine at all points was 0mg/l. This was probably because all raw samples had been taken and analysed.

xi. Taste &Odour

Taste and Odour was Un-Objectionable at all points.

xii. Total coliforms

Bacteriological contamination was found at all points except at Verinag (Table 2). The reason for the bacteriological contamination may be that at most of the places all the waste products, animal debris, plastic waste, were thrown to the river Jhelum which has resulted in the biological contamination of all samples. Bacteriological parameters were analysed using H_2S Vials. Researchers have reported similar results and contamination from domestic and commercial sewage from Srinagar city (Mehmood et al. 2017). Agricultural activities, indiscriminate use of chemical fertilisers, pesticides, and unplanned development are the factors for the deterioration of water quality in the Jhelum (Mehmood et al. 2017).

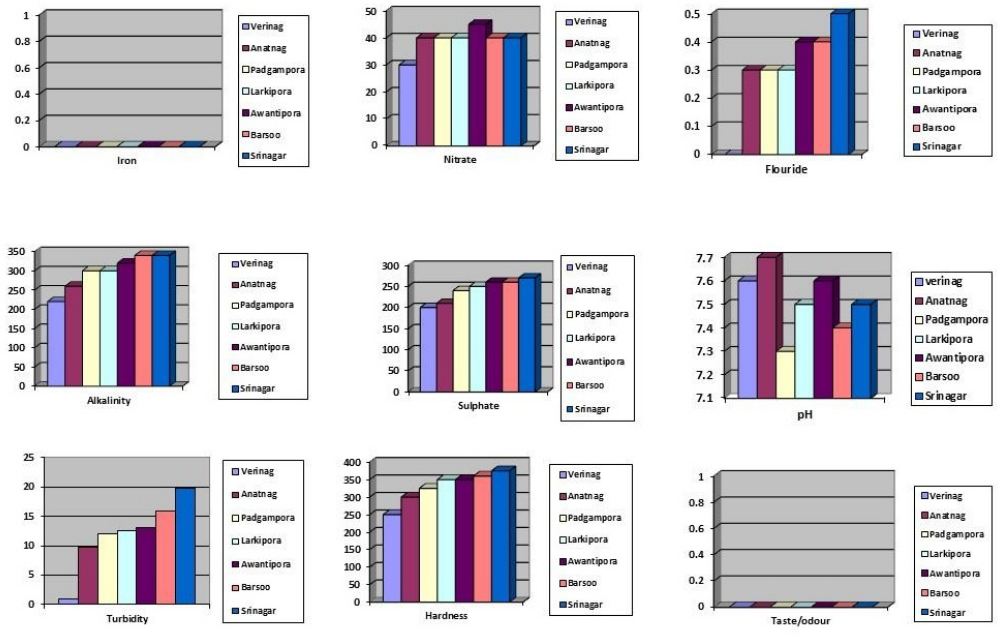

Figure 4: Graphical Representation of Analysed Parameters in Jhelum River.

Following the 2014 floods, the government has given special focus on the river Jhelum. The river has been ignored for far too long, according to the Centre for Science and Environment's report Down to Earth (2017), which states that the organic load is extremely high, and bacteria require more oxygen for respiration, resulting in decreased dissolved oxygen levels. Due to excessive pollution loads, the government had also issued some advice to avoid eating fish.One of the most significant aspects in the operation and growth of an aquatic ecosystem is temperature. It is crucial to aquatic chemistry and life's functioning and activities.The temperature of river Jhelum ranged on an average of 16℃ over the sampling period due to fluctuations the atmospheric temperature. The results obtained in the current study that the geographical location and season have a direct impact on the various physico-chemical and biological characteristics of river Jhelum. The alkaline nature of water could be attributed to the buffering properties of some inorganic substances (Kang et al., 2001). The gradual increase in chloride concentration down the river could be due to the increase in urban land use and due to the addition of some industrial/factory discharge (Livingstone, 1963; Woods, 1965; Allan, 1996). The pH in the river may be attributed to domestic sewage, as the decomposition of the organic matter results in the decrease in the pH value and increase in the carbon dioxide.Similar reports have been reported (Kalal et al. 2021). In rivers the occurrence and abundance of components of carbonate system and the pH are determined primarily by current and chemical nature of the substrate (Reid, 1961). Nitrate occurs in small quantities in unpolluted water but sewage contamination results in a significant increase in its contents. Usually, higher nitrate concentrate concentrations are associated with fertilizer application or human excreta wastes. In the present study we observed bacteriological contamination at all all points except Verinag and higher turbidy values which indicate biological pollution. The water is centainly unfit for human consumption.

FOCUSSED GROUP DISCUSSION

The focused group discussion and interaction with locals on Water Conservation Management and Sanitation gave us an indication of people's knowledge, attitudes, and awareness levels about water quality, cleanliness, and contamination in the Kashmir Valley (Figure 5).Most of the respondents were satisfied with the quality of their drinking water. Age and sex did not seem to play significant roles in the degree of public satisfaction with water quality or in the public perception of water pollution accidents; however, residents in rural areas within a drinking water quality monitoring network seemed more satisfied with their drinking water quality and more aware of drinking water contamination accidents than in areas outside of such a network. Respondents with higher education levels had greater awareness than those with lower education levels with respect to water quality and water pollution accidents. The village heads/panchayat members and some individuals especially the younger population seemed enthusiastic to actively participate in the cleaning of their environment and water bodies. Several Mohalla committees and panchayat members are actively involved in water conservation and contamination prevention, including the river Jhelum although few members were preoccupied with their own companies and have no time for such activities while some of them were not aware of the need for such activiites. There was awareness regarding plastic being the primary source of pollution in water bodies and they wanted a complete ban on plastic bags. They also suggested that trash bins for each household should be advocated.

Fig. 5:Interaction with locals on Water Conservation Management & Sanitation.

The Government launched the Swachh Bharat Mission (Gramin) on 2nd October 2014 to accelerate efforts to achieve universal sanitation coverage, improve cleanliness and eliminate open defecation in India by 2nd October 2019. The program is considered India's biggest drive to improve sanitation, hygiene, and cleanliness in the country. The effectiveness of the programme is predicted upon generating demand for toilets leading to their construction and sustained use by all the household members. It also aims to promote better hygiene behaviour amongst the population and improve cleanliness by initiating Solid Waste Management (SWM) projects in the villages of the country. This is to be bolstered with adequate implementation capacities in terms of trained personnel, financial incentives and systems and procedures for planning and monitoring. The emphasis is on stronger focus on behaviour change intervention including interpersonal communication; strengthening implementation and delivery mechanisms down to the GP level; and giving States flexibility to design delivery mechanisms that consider local cultures, practices, sensibilities and demands (https://swachhbharatmission.gov.in). Moreover, another initative by the Government of India was implemented wherein water quality monitoring and survillence is being given top priority as per the guideline of Jaljeewan mission which says that every household must get clean tap water also.

Awareness Programmes Conducted: Generation of environmental awareness is the most effective strategy for bringing about societal change in terms of cleanliness, environmental health, hygiene, social stigmas, taboos, and soon. It was therefore decided to prepare material and messages for awareness programmess based on the focused group discussions held. Pamphlet distribution, as well as the creation and distribution of suitable information, education, and communication (IEC) material to targeted beneficiaries, were used to raise environmental consciousness in the society. Awareness campaigns were conducted to educate the people regarding environmental pollution, health, and sanitation. Some awareness programmes were organized for this study in order to reach a wider audience and have a better impact (Figure 6).

Figure 6: Awareness programmes conducted regarding environmental pollution.

CONCLUSION

The present study shows that the parameters analysed are within the permissible limits along the river Jhelum. Biological contamination has been observed at all points except Verinag and has caused contamination of the river body posing a great threat to the living forms. Steps should be taken by the Government to always ensure the pristine quality of the river. During focused group discussions, it was observed that there was a considerable level of awareness among most people, and they were also motivated towards helping keep the water clean. Participations in awareness campaigns helped to increase their knowledge, remove misconceptions and further motivate the groups. In addition to the efforts by our governments, inputs and support from both organized and unorganized sectors are required for keeping our rivers clean

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FOOD SECURITY IN CHHATTISGARH DURING COVID-19: THE ROLE OF PDS

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Abstract
Covid-19 began as a public health crisis and has implications for food security. The State of Food Security & Nutrition in the World 2021 report notes that the pandemic has made it harder to achieve food security, the 2020 estimate for the prevalence of undernourishment was between 9.2 to 10.4%. Even before the pandemic, India accounted for the highest number of undernourished people in the world. Two pillars of food security are access and availability. The access can be improved by increasing the incomes of consumers or making the grains cheaper. The Public Distribution System (PDS) does the latter by subsidizing food grains. In a time of declining availability of food grains and access due to a fall in income levels, the government scheme has the potential to ensure food security. This scheme has been extended multiple times since March 2020, most recently till March 2022.Thus, measuring its impact in Chhattisgarh is a fruitful exercise. This paper aims to answer the following question: does the Pradhan Mantri Garib Kalyan Ann Yojana, which guarantees households 5 kilograms of free rice or wheat and 1 kilogram of pulses, improves food security in Chhattisgarh? Ideally, the provisioning of free rice and wheat (cereals) should cause a shift in food expenditure away from cereals to other food groups.

Keywords
Food security, Pandemic, Public Distribution System.

Introduction

Covid-19 was declared a pandemic on March 11, 2020. What began as a public health crisis has implications for food security. The State of Food Security & Nutrition in the World 2021 report notes that the pandemic has made it harder to achieve food security. The 2020 estimate for the prevalence of undernourishment was between 9.2 to 10.4%. Even before the pandemic, India accounted for the highest number of undernourished people globally (22% of the world's undernourished). Despite India being a major food producer and is attributed to economic inequality and high unemployment, limiting the means of procuring food.

The National Food Security Act, 2013 guarantees a regular flow of subsidized food grains for Antyodaya Anna Yojana and Priority Households. The former is guaranteed 35kgs a household while the latter is given 5kg of grains per person. This includes rice, wheat, and kerosene. As the national lockdown was initiated, the finance minister announced the Pradhan Mantri Gareeb Kalyan Anna Yojana (PMGKAY). The scheme guarantees an additional 5kg of free-of-cost food grains (rice or wheat) to NFSA beneficiaries. This was meant to be a temporary measure from April to June 2020, but given the pandemic situation, had been extended till March 2022. The scheme also guarantees 1kg of pulses per household.

Two pillars of food security are access and availability. The access can be improved by increasing the consumers' incomes or making the grains cheaper. The Public Distribution System (PDS) does the latter by subsidizing food grains. PMGKAY hoped to tackle the non-availability of food grains. The scheme supports almost 75 crore beneficiaries. The lockdown had put daily wage earners and workers out of jobs and reduced their purchasing power. The free grains were insurance for food security. This ties in with the larger conversations around PDS becoming a rights-based

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rather than a welfare-based approach. However, the larger problems surrounding the awareness of individuals, leakages that plague the PDS, diversion of foodgrains, improper and incomplete identification of beneficiaries, and a general lack of monitoring and accountability remained.

Food security via the PDS is possible only through effective implementation. In a time of declining availability of food grains and access due to a fall in income levels, the government scheme has the potential to ensure food security. Thus, measuring its impact in Chhattisgarh is a fruitful exercise. According to the Yale Economic Growth Center, 99% of PDS were shops open, 92 - 99% had adequate supplies and 99% provided free allotments to citizens in the state. Chhattisgarh extended an additional food kit to all NFSA and Annapurna card holders, those disabled and destitute; this included the NFSA rice (Chhattisgarh's staple diet) being provided for free for two months. The question we hope to answer through this paper is: does the Pradhan Mantri Garib Kalyan Ann Yojana, which guarantees households 5 kilograms of free rice or wheat and 1 kilogram of pulses, improves food security in Chhattisgarh?

Literature Review

The PDS is a center-state scheme. The Center handles the procurement, storage, and allocation of grains to states, while the states are responsible for identifying beneficiaries and implementation. Khera (2011) and Dreze and Khera (2015) note the vast disparities between states in terms of PDS leakages. At the same time, the Food and Agriculture Organization noted that India's bumper wheat harvest was affected due to a shortage of labor and transportation, as were vegetables and fish, which affected the food availability.

In Kenya, the introduction of government measures reduced the percentage of households below the daily threshold from 3.32 percentage points to 1.26 percentage points. They also find that rural households witness a larger change in their caloric intake. Harris et al. (2020) evaluate the impact of the pandemic on vegetable producers and a majority reported a decline in sales, prices, and income. 62% of these households had to change their diets; per Bennett's Law, most preserved their staple intake but witnessed a fall in fruit and animal sources (other than dairy). An Inter-Agency Group researched food security in Odisha and found that over 50% of households reported insufficient food availability, with lack of adequate funds being the primary reason. Two-thirds of the households reported that the PDS was a major source of support to meet the food shortage. In UP, there was a 41% increase in food security between December 2019 and September 2020, and the coping strategy was to reduce non-food expenditure.

Roy et al. (2021) analyze the scheme's impact in Bihar, Eastern Uttar Pradesh, and Odisha. We agree that while the cereal provision is adequate since it tops up the existing entitlements to families, the 1kg of pulses will be insufficient as most households consume between 4 - 5kgs of pulses a month. The pandemic caused large supply chain issues and inflation, thus, making it hard for households to have a diversified and adequate diet. They find that since entitlements are per-capita, those with bigger families win while smaller families lose out and almost a third of the population is unaware of their entitlements. Even before the pandemic, a majority of the households were supplementing their PDS grains through market purchases, with the driving reason being the insufficient quantity of rice being distributed. This could be because

Appendix

Simple Regression Results

December 2019

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. use "D:\Ashu\Ashoka Semesters\Sem 6\Food Security\Data\Weighted data\December2019_CH_Weighted.dta"

. regress total_expenditure monthly_expense_on_food monthly_expense_on_education monthly_expense_on_recreatior
>  monthly_expense_on_health
```

Source	SS	df	MS		
				Number of obs	= 4,799
				F(4, 4794)	= 1219.13
Model	8.3448e+11	4	2.0862e+11	Prob > F	= 0.0000
Residual	8.2036e+11	4,794	171122024	R-squared	= 0.5043
				Adj R-squared	= 0.5039
Total	1.6548e+12	4,798	344901370	Root MSE	= 13081

total_expenditure	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
monthly_expense_on_food	1.129497	.0243961	46.30	0.000	1.08167	1.177325
monthly_expense_on_education	1.014314	.0244945	41.41	0.000	.9662938	1.062335
monthly_expense_on_recreation	11.14788	1.059575	10.52	0.000	9.070625	13.22513
monthly_expense_on_health	4.307042	.4489498	9.59	0.000	3.426895	5.18719
_cons	3227.27	219.8247	14.68	0.000	2796.313	3658.227

April 2020

```
. use "D:\Ashu\Ashoka Semesters\Sem 6\Food Security\Data\Weighted data\April2020_CH_Weighted.dta"

. regress total_expenditure monthly_expense_on_food monthly_expense_on_education monthly_expense_on_recreation
>  monthly_expense_on_health

      Source |       SS           df       MS      Number of obs   =     4,799
-------------+----------------------------------   F(4, 4794)      =  39940.38
       Model |  3.3316e+10         4  8.3291e+09   Prob > F        =    0.0000
    Residual |   999730322     4,794  208537.823   R-squared       =    0.9709
-------------+----------------------------------   Adj R-squared   =    0.9708
       Total |  3.4316e+10     4,798  7152157.74   Root MSE        =    456.66

------------------------------------------------------------------------------
total_expenditure | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
------------------+-----------------------------------------------------------
monthly_expense_on_food |   1.701835   .0143145   118.89   0.000     1.673772   1.729898
monthly_expense_on_education |   2.056005   .1396005    14.73   0.000     1.782324   2.329686
monthly_expense_on_recreation |   2.078624   .4347632     4.78   0.000     1.226289    2.93096
monthly_expense_on_health |   .6292056   .0989472     6.36   0.000     .4352237   .8231875
                _cons |   538.8229    39.2987    13.71   0.000     461.7794   615.8664
------------------------------------------------------------------------------
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March 2020

```
. use "D:\Ashu\Ashoka Semesters\Sem 6\Food Security\Data\Weighted data\March2021_CH_Weighted.dta"

. regress total_expenditure monthly_expense_on_food monthly_expense_on_education monthly_expense_on_recreation
>  monthly_expense_on_health

      Source |       SS           df       MS      Number of obs   =     4,799
-------------+----------------------------------   F(4, 4794)      =   9797.28
       Model |  2.2134e+11         4  5.5334e+10   Prob > F        =    0.0000
    Residual |  2.7076e+10     4,794  5647900.45   R-squared       =    0.8910
-------------+----------------------------------   Adj R-squared   =    0.8909
       Total |  2.4841e+11     4,798  51774115.6   Root MSE        =    2376.5

------------------------------------------------------------------------------
total_expenditure | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
------------------+-----------------------------------------------------------
monthly_expense_on_food |    2.03873   .0188606   108.09   0.000     2.001755   2.075706
monthly_expense_on_education |   3.485874   .1052643    33.12   0.000     3.279508    3.69224
monthly_expense_on_recreation |   2.608995   .5068638     5.15   0.000      1.61531   3.602681
monthly_expense_on_health |    2.79065   .1150187    24.26   0.000     2.565161    3.01614
                _cons |   1065.651   63.37927    16.81   0.000     941.3986   1189.904
------------------------------------------------------------------------------
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October 2021

```
. use "D:\Ashu\Ashoka Semesters\Sem 6\Food Security\Data\Weighted data\October2021_CH_Weighted.dta"

. regress total_expenditure monthly_expense_on_food monthly_expense_on_education monthly_expense_on_recreation
>  monthly_expense_on_health

      Source |       SS           df       MS      Number of obs   =     4,799
-------------+----------------------------------   F(4, 4794)      =   7484.86
       Model |  1.9199e+11         4  4.7997e+10   Prob > F        =    0.0000
    Residual |  3.0742e+10     4,794  6412550.04   R-squared       =    0.8620
-------------+----------------------------------   Adj R-squared   =    0.8619
       Total |  2.2273e+11     4,798  46421401.7   Root MSE        =    2532.3

------------------------------------------------------------------------------
total_expenditure | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
------------------+-----------------------------------------------------------
monthly_expense_on_food |   1.905212   .0160223   118.91   0.000     1.873801   1.936623
monthly_expense_on_education |    2.18386   .0578713    37.74   0.000     2.070406   2.297314
monthly_expense_on_recreation |   4.332962   .5370139     8.07   0.000     3.280168   5.385755
monthly_expense_on_health |   2.943455   .1138028    25.86   0.000     2.720349    3.16656
                _cons |   1445.629   72.99815    19.80   0.000     1302.519   1588.739
------------------------------------------------------------------------------
```

household members had not been accounted for on the ration card due to delays in updates, and when allotment is per capita, this becomes important. They conclude that while the PDS delivers, the non-pandemic problems of choice constraint and exclusion persist.

Krishnamurthy et al. (2014) evaluate the impact of NFSA on food security in Chhattisgarh due to the reforms carried out in the state. They found a 400% increase in the consumption of PDS entitlements. The districts also increased their consumption of non-grains like pulses, animal-based protein, and produce by 13 percentage points. The relative increase in pulses was greater than other non-gain groups. This is because Chhattisgarh is a poor state with close to 30% of its population living below the poverty line, and they choose cheaper sources of non-grains before substituting towards more expensive means like meat. They also show that since the PDS rice consumption has increased over the years, grain consumption (relative to non-grains) has risen. Between 2007 and 2011, malnutrition in the state fell by 16%. The state government attributes it to the successful implementation of the PDS that allows money to be saved and opens the option to supplement via market purchases.

The pandemic is a severe negative income shock. The International Labor Organization predicted that the pandemic would push 400 million Indians into poverty. The demand for employment under the National Rural Employment Guarantee Act also rose in the first few months of the lockdown, almost double the average between 2013 - 19. Block et al. (2004) analyze the impact of the Indonesian Financial Crisis of 1997 on children's nutritional outcomes. They found that intake of micronutrient-rich food substantially declined, reversed a 20-years of nutritional improvement, and the prevalence of anemia in mothers and children increased.

The cereal price index tripled between 2000 and 2008 (the Great Financial Crisis). Brinkman et al. (2010) assess the impact of crises on food consumption and diet diversity. They conclude that crises lead to a reduction in the quality and quantity of food consumed. Vulnerable groups will shift to cereals, food that gives them enough calories but not nutrients. Most farm-holdings in India are small, resulting in farmers being net buyers. The authors believe that such households will be adversely affected by high food prices, especially if they sell at low prices but purchase at higher prices in the lean season.

The role played by PDS is extremely crucial during a crisis. This is in line with Hoynes and Schanzenbach (2009), who evaluated the Food Stamp Scheme in the United States. It was the largest income transfer program for low-income populations, costing the government $27billion. The scheme leads to a reduction in out-of-pocket food expenditure and an increase in overall food expenditure. Given that food expenditure is positively related to food consumption, food consumption will rise too. We expect this to play out in Chhattisgarh as well.

Material

We use data from the Consumer Pyramids Household Survey collected by the Center for Monitoring Indian Economy. They collect information on expenditure (in rupees) rather than quantity and work on the assumption that consumption expenditure is an effective proxy for consumption. Data from December 2019 provides us with our baseline estimate as it is the pre-pandemic level, April 2020 helps us examine the immediate impact of the pandemic, March 2021 presents the impact a year after the government first implemented the policy, and October 2021 is the medium-term impact after 1.5 years. We have retained most variables in their original form. The only new variables created were composite variables for beverages, sweets, and meat consumption. This was done after verifying that when subcomponents were summed, they gave the composite variable. This allows us to examine the impact on food groups comprehensively.

Caveats of the data include the unavailability of income data which doesn't allow us to examine what proportion of the income is being consumed versus saved. Secondly, since the data accounts for consumption expenditure, we cannot discern the impact of inflation on the quantities. Lastly, we are examining the impact of PDS alone on food security; unlike the IHDS data, CMIE doesn't provide the breakdown of the source of the cereals and pulses, and no reliable source could be found for how much of the consumption is via the PDS. We presume that since the rice subsidy is large, the entirety of consumption for cereals will be met via the PDS and partially for pulses. Lastly, India also introduced certain cash transfers, which would have increased income and could distort consumer behavior.

Method

We are running a regression equation to estimate the effects of changes in consumption expenditure across different groups on the total consumption expenditure of a household.

Our coefficient of interest is β_2, which reflects the relationship between total monthly expenditure and monthly expenditure on food. We believe that β_2 will be positive due to the low elasticity of food expenditure even if the incomes are falling. At the same time, we expect expenditure on education, recreation, and health to fall. However, this doesn't reflect the changes in the dietary composition of household diets. We use the CMIE data to run the regression and evaluate the changes in individual food groups. We realize a bias in the data set on tabulating the data because there is a significantly greater number of observations for urban households. However, in reality, Chhattisgarh is predominantly rural and the sample wouldn't be representative of the population. We weight the data using household sizes to control for this, assuming that rural households tend to be bigger.

Results

All the coefficients are positive and significant at a 95% confidence interval from the baseline regression. Further, all the independent variables are positively correlated with the

total expenditure. There is a sharp increase in the expenditure share of food in April 2020, which coincides with the imposition of the national lockdown in India. This can be attributed to the fall in incomes due to loss in employment. We hypothesize that this increase in food expenditure was due to a shift away from health, education, and recreation. Within food expenditure, we expect substitution away from nutrition towards maintaining caloric intake. This would result in increased cereal consumption. Table 2 indicates that the coefficient of monthly expense on cereal doesn't rise over time but remains positive and significant across the months. There is a decrease in cereals' mean food budget share between December 2019 and April 2020 (Figure II). This could be because the PDS supplies the majority of the household's needs. We believe this could be because of the scheme being implemented and its tangible impact being felt by households.

Table 1: Simple Regression's Coefficients Over the Months.

Monthly Expense On	Coefficient of variables for regression			
	December 2019	April 2020	March 2021	October 2021
Food	1.13	1.70	2.04	1.91
Education	1.01	2.06	3.49	2.18
Recreation	11.15	2.08	2.61	4.33
Heath	4.31	0.63	2.79	2.94
Constant	3227.27	538.82	1065.65	1445.63

Table 2: Detailed Regression's Coefficients Over the Months.

Monthly Expense On	Coefficient of variables for regression			
	December 2019	April 2020	March 2021	October 2021
Cereals whole	3.35	2.96	1.84	4.82
Pulses	2.67	-0.44	0.73	0.55
Vegetables	2.58	1.95	2.87	5.03
Milk and milk products	10.29	2.34	9.98	1.22
Food in restaurants	3.98	1.15	7.19	-1.28
Recreation	4.86	-3.47	0.20	2.08
Cooking fuel	0.38	1.02	0.90	1.66
Education	1.00	1.27	2.44	1.85
Health	1.28	1.07	1.77	1.63
Oils and fats	-5.91	1.31	1.27	-2.72
Non-veg	4.92	3.45	0.75	1.41
Sweet	-14.60	3.59	-4.26	-0.83
Beverages	16.11	-5.69	0.97	2.05
Constant	4371.97	640.78	2438.91	1748.61

Coefficients that are underlined are not statistically significant at the 95% and 99% confidence levels.

Table 3: Mean Monthly Expense on Food and Total Expenditure for Weighted Sample.

Month	Mean Monthly Expense on Food	Mean Monthly Total Expenditure	Mean Expenditure Share of Food (base December 2019)	Change in Mean Expenditure Share of Food
Dec-19	3483.19	8682.52	40.12%	0%
Apr-20	773.50	1549.08	49.93%	24.47%
Mar-21	2390.49	6427.20	37.19%	-7.29%
Oct-21	3917.70	9952.53	39.36%	-1.88%

Table 4: Mean Monthly Expense on Cereals and Food for Weighted Sample.

Month	Mean Monthly Expense on Cereals Whole	Mean Monthly Expense on Food	Mean Food Budget Share on Cereals Whole	Change in Mean Food Budget Share on Cereals Whole (base December 2019)
Dec-19	457.21	3483.19	13.13%	0.00%
Apr-20	58.34	773.50	7.54%	-42.54%
Mar-21	238.34	2390.49	9.97%	-24.04%
Oct-21	412.80	3917.70	10.54%	-19.73%

Table 5: Mean Monthly Expense on Pulses and Food for Weighted Sample.

Month	Mean Monthly Expense on Pulses	Mean Monthly Expense on Food	Mean Food Budget Share on Pulses	Change in Mean Food Budget Share on Pulses (base December 2019)
Dec-19	171.90	3483.19	4.94%	0.00%
Apr-20	-3.49	773.50	-0.45%	-109.14%
Mar-21	120.92	2390.49	5.06%	2.49%
Oct-21	242.31	3917.70	6.19%	25.33%

*The mean expense on pulses is negative for April 2020 because the data has observations where the monthly expenditure on pulses is negative. While negative observations are present for most food groups, they are significantly greater in number for pulses which is giving us a negative mean.

Table 6: Mean Monthly Expense on Health for Weighted Sample.

Month	Mean Monthly Expense on Health	Mean Monthly Total Expenditure	Mean Expenditure Share of Health	Change in Mean Expenditure Share of Health (base December 2019)
Dec-19	217.49	8682.52	2.50%	0.00%
Apr-20	-42.71	1549.08	-2.76%	-210.08%
Mar-21	137.29	6427.20	2.14%	-14.73%
Oct-21	246.43	9952.53	2.48%	-1.16%

Table 7: Mean Monthly Expense on Education for Weighted Sample.

Month	Mean Monthly Expense on Education	Mean Monthly Total Expenditure	Mean Expenditure Share of Education	Change in Mean Expenditure Share of Education (base December 2019)
Dec-19	362.78	8682.52	4.18%	0.00%
Apr-20	-66.17	1549.08	-4.27%	-202.23%
Mar-21	57.15	6427.20	0.89%	-78.72%
Oct-21	164.34	9952.53	1.65%	-60.48%

Table 2 shows a negative correlation between the monthly expenditure on pulses and the total monthly expenditure in April 2020. This is the month when incomes had fallen by the largest. In the first wave, there was a 44% fall in the average all-India monthly per capita household income between February and April 2020. Further, there was a 15.85% increase in inflation in "pulses and products" from March 2019 to March 2020. Table 2 shows that the coefficient for monthly expense on pulses is significant only in April 2020, which could be because of the sudden emphasis on free pulses in PMGKAY. The PDS in Chhattisgarh provided 2kg of pulses to priority households at Rs. 10 or Rs. 5 per kg, depending on the area, but not for free. We notice that the mean consumption expenditure on pulses is negative in April 2020 (Table 5). The percentage of households with negative values in December 2019 was 35.01%, rose to 69.76% in

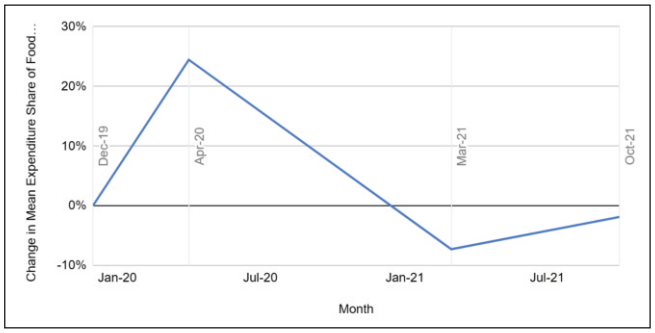

Figure 1: Change in Mean Expenditure Share of Food.

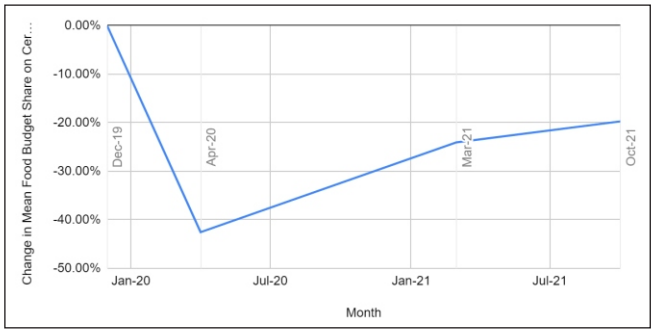

Figure 2: Change in Mean Expenditure Share of Cereals.

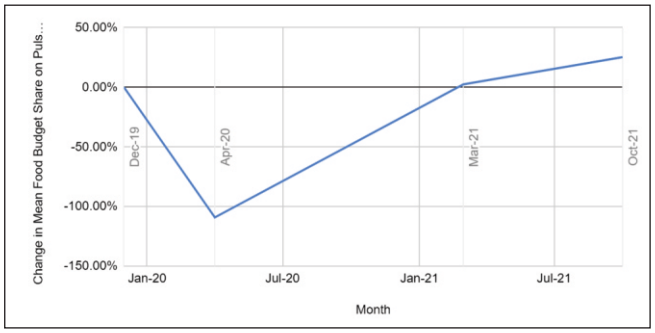

Figure 3: Change in Mean Expenditure Share of Pulses.

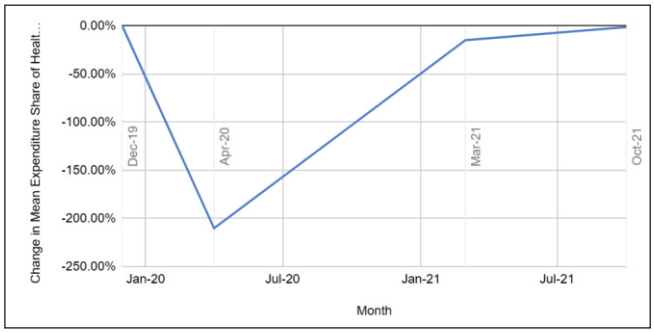

Figure 4: Change in Mean Expenditure Share of Health.

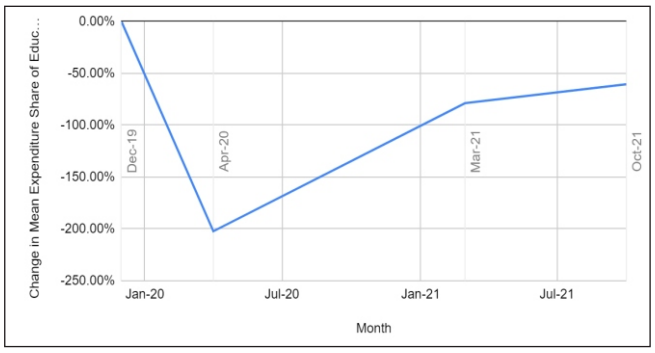

Figure 5: Change in Mean Expenditure Share of Education.

April 2020, came down to 45.20% in March 2021, and fell to 16.92% in October 2021. This immediate increase in the proportion of households availing subsidies can be attributed to the national lockdown, while the gradual fall coincides with the economy recovering and incomes rising.

Table 2 shows that the coefficient of milk and milk products comes down drastically from December 2019 to April 2020 from 10.29 to 2.34. This seems to be the direct result of the pandemic which impacted the country. Interestingly, the coefficient recovered to 9.98 in March 2021, as the incomes would have recovered post the pandemic. The per capita household incomes were just 3% lower than the pre-pandemic level of February 2020. However, the coefficient again goes down to 1.22 between March 2021 and October 2021. Incomes fell again before a recovery happened as India faced the severe second wave of the pandemic from February 2021. India's per capita income fell by 19% between January and May 2021. A negative correlation is observed for monthly expenditure on monthly expenditure on beverages.

We observe a 210% fall in the mean expenditure share of health in April 2020 compared to December 2019 (Table 6). During a health crisis, the expenditure share on health might go up due to expenses on hospitalization, sanitizers, and facemasks. The decline in expenditure shares of health and education indicates economic distress. This could also reflect reliance on public hospitals instead of private hospitals, due to which the household expenses didn't go up. As reflected in Figure I, the substitution away from health could be towards food. The model regression's coefficients support this.

We observe a decline in the mean expenditure share on education with the onset of the pandemic (Table 7). This is expected because households will substitute for necessities. The fall could also be attributed to the closure of schools and reduced out-of-pocket expenditure on education. This is expected to impact the long-run labor market outcomes and economic development. The affected students face long-term losses in income. This is because loss in schooling has direct consequences for the cognitive and socio-economic development of the affected children, which affects their job prospects. Further, economies would face lower economic growth due to a less skilled labor force. In addition, this can be expected to have a danger of further increasing future inequality in society.

The question of efficacy of PDS to meet nutritional requirements is age-old. A survey conducted by MicroSaveConsulting in August 2019 found that PDS accounts for about 40% of an average beneficiary's monthly food grain consumption at the household level. However, it found that most beneficiaries had low levels of basic macro and micronutrients, including protein, fat, calcium, iron and folic acid. One can conclude that the PDS has not improved

the nutritional requirements and the primary reason seems to be the lack of dietary diversity. However, the other argument is that the PDS leads to savings for the households by providing them cereals at a subsidized rate. The households can use these savings to expand their dietary diversity to include more non-cereal foods and improve nutritional outcomes. Despite this reasoning, there is prevalence of nutritional deficiencies amongst the beneficiaries and it makes the case for non-cereal foods to be introduced in PDS. On analyzing our data, we see that the coefficient for monthly expenses on vegetables increases, while it falls for milk and milk products, non-vegetarian food, and beverages (Table 2). This could imply a fall in dietary diversity. This can be attributed to the government's focus on ensuring hunger eradication as opposed to meeting nutritional needs.

Limitations

The first limitation of the data is that CPHS is a self-reported survey. It is subject to a reporting bias. While CMIE tries to control for recollection by conducting monthly surveys, we aren't using those estimates for uniformity concerns. Secondly, our analysis has established a correlation between the variables but not causality. This means our relationships could be bidirectional. Lastly, we believe the data is not adequately weighted to be representative of the population. We say this because data is systematically unavailable for household sizes across all four months. We notice that the proportion of households with greater than four members is the same across rural and urban areas. This also indicates a problem in data collection itself– the number of missing values is as high as 73% in the rural areas for April 2020. Therefore, our data might have an urban bias.

Conclusion

The livelihoods survey by Azim Premji University found that 77% of households were eating less during the lockdown than before. This situation has persisted even months after the lockdown for 60% of the households. Our paper has shown that the expenditure on food has increased after the pandemic above the pre-pandemic levels. As concluded in our results section, dietary diversity has reduced with only the coefficient of monthly cereal expenditure rising. The increase in food expenditure could be because the large exclusion errors associated with PDS have forced people to spend more to keep up previous caloric intake levels through non-cereal sources, but the dietary diversity hasn't reached pre-pandemic levels. Within Chhattisgarh, 31% of the population doesn't possess NFSA ration cards and wouldn't have been able to access PMGKAY. The additional demand (of approximately 32 million tons) generated by the scheme is being met by the excess procurement, which was at an unprecedented level of 42.3 million tons of wheat and 55.4 million tons of rice by the Food Corporation of India. During the pandemic, as Bhalla et al. (2022) point out, India's food subsidy expanded to provide the basic ration required by a household to over two-thirds of its population and was important in providing income in the form of food subsidies to households, allowing them maintaining intake through the PDS and diversify by spending in the open market. However, while PMGKAY ensures the food availability and access pillars of food security, the nutrition outcome of a cereals-focused food safety net is detrimental.

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CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL PROPERTIES OF ANISE SEEDS (*PIMPINELLA ANISUM* L.)

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Abstract
Pimpinella anisum (anise), belonging to Umbelliferae family, is an aromatic plant which has been used In Iranian traditional medicine (especially its fruits) as carminative, aromatic, disinfectant, and galactagogue. *Pimpinella anisum* is a plant rich in volatile oils, which are employed in the folk medicine. So far, different studies were performed on aniseeds and various properties such as antimicrobial, antifungal, antiviral, antioxidant, muscle relaxant, analgesic and anticonvulsant activity as well as different effects on gastrointestinal system have been reported of aniseeds. It can also reduce morphine dependence and has beneficial effects on dysmenorrhea and menopausal hot flashes in women. In diabetic patients, aniseeds showed hypoglycemic and hypolipidemic effect and reduce lipid peroxidation. The most important compounds of aniseeds essential oil were trans-anetole, estragole, γ-hymachalen, para-anisaldehyde and methyl cavicol.

Keywords
Galactagogue, Anethole, Hypoglycemic effect, Antifungal, Analgesic

Introduction

Pimpinella anisum L., an annual herb belonging to the Umbelliferae family, is one of the oldest medicinal plants. It is an annual grassy herb with 30–50 cm high, white flowers, and small green to yellow seeds, which grows in the Eastern Mediterranean Region, West Asia, the Middle East, Mexico, Egypt, and Spain. *P. anisum* is primarily grown for its fruits (aniseeds). Anise is grown for fruit (Anisifructus), containing essential oil (Anisiaethroleum) with trans-anethole which is a dominant compound and has a characteristic sweet taste and smell. *Pimpinella anisum* has been used as carminative, aromatic, disinfectant, and galactagogue. [1-3]Anise seed contains volatile oil, fixed oil, proteins, mucilage and starch. Essential oil of Anee seeds contains eugenol trans-anethole, anisaldehydeestragole, coumarins, scopoletin, umbelliferon, estrolterpene hydrocarbons polyenes and polyacetylenes, methyl chavicolanisaldehyde. Aniseeds contain 1.5–5% essential oil and used as flavouring, digestive, carminative, and relief of gastrointestinal spasms. Consumption of aniseed in lactating women increases milk and also reliefs their infants from gastrointestinal problems. Anise seeds are used as analgesic in migraine and also as carminative, aromatic, disinfectant, and diuretic in traditional medicine [4]. Aniseed has warm and dry nature and can increase milk production, menstruation, urine, and sweat secretion and also making good complexion. It is also effective in polishing of teeth. In some traditional texts, anise is mentioned for melancholy, nightmare, and also in treatment of epilepsy and seizure. Aniseed or anise essential oil is derived from anise or aniseed. More often than not, this oil is confused with star anise essential oil but that oil comes from star anise plant, scientifically known as Illicum verum. The plant is prevalent in the Mediterranean regions and it undoubtedly has a long historical record. In fact, it was introduced to northern Europe by the Romans after they discovered that the aniseed herb could be used as a digestive, specifically added to cakes which contained other digestive seeds like cumin and fennel, eaten after meals. Early settlers brought it to North America. Its essential oil possesses a very distinctive aroma that resembles that of black licorice and it is widely known for its digestive benefits. However, aniseed oil also contains other potent health benefits. [4-7]

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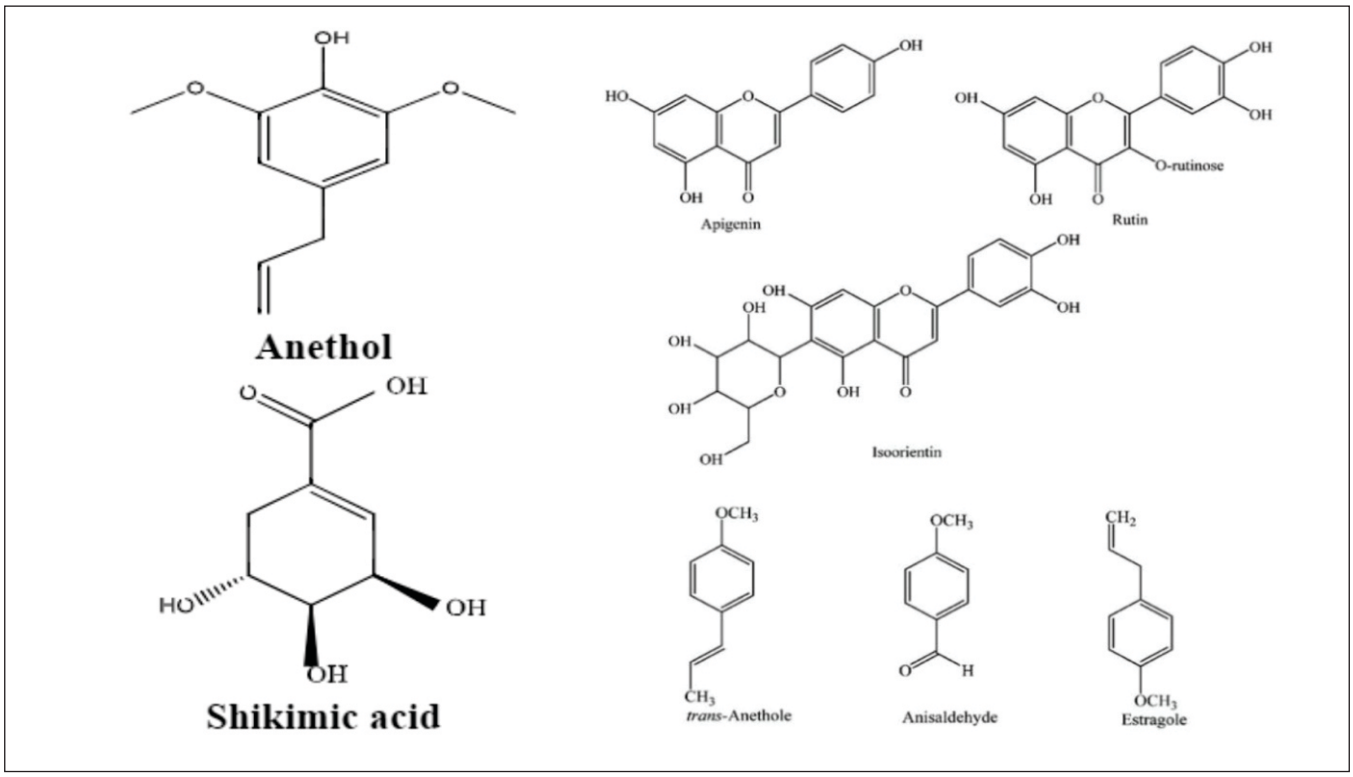

Figure 1: Chemical structures of aniseed constituents.

Chemical Constituents

The chemical constituents of aniseed extract obtained by Supercritical extraction using CO_2 were determined by GC-MS. The major compounds were anethole (~90%), γ-himachalene (2−4%), p-anisaldehyde (<1%), methylchavicol (0.9−1.5%), cis-pseudoisoeugenyl 2-methylbutyrate (~3%), and trans-pseudoisoeugenyl 2-methylbutyrate (~1.3%). A new terpene hydrocarbon called neophytadiene was isolated from aniseed. 4-(β-D - glucopyranosyloxy) benzoic acid which is one of the phenolic glycosides of the Umbelliferae family was also isolated from aniseed. Four aromatic compound glucosides, an alkyl glucoside, and a glucide were isolated as new compounds from the polar portion of methanolic extract of anise fruits. The structures of the new compounds were clarified as (E)-3-hydroxy-anethole β-D-glucopyranoside, (E)-10-(2-hydroxy-5-methoxyphenyl) propane β-D-glucopyranoside, 3-hydroxyestragole β-D-glucopyranoside, methyl syringate 4-O-β-D-glucopyranoside, hexane-1,5-diol 1-O-β-D-glucopyranoside, and 1-deoxy-l-erythritol 3-O-β-D-glucopyranoside. Isolation and structure elucidation of flavonoid constituents from anise, caraway, coriander, and fennel by means of chromatography on cellulose columns lead to isolation of quercetin 3-glucuronide, rutin, luteolin 7-glucoside, isoorientin, and isovitexin as crystalline compounds and apigenin 7-glucoside and a luteolin glycoside as noncrystalline compounds from anise. Pectin substances isolated from the Pimpinella anisum herbs, was found that pectin substances are practically not toxic and exhibit pronounced laxative effect. Water Soluble polysaccharide Compounds isolated from the Pimpinella anisum herbs contain two monosaccharides - glucose and ramnose. [8-11]

Figure 2: Anise plant and inflorescence.

Pharmacological aspects

Anise is used in folk medicine in many countries for treatment of digestive, respiratory and neurological diseases, as well as natural estrogen. It has been found recently to have anti-cancer, antioxidant and antimicrobial properties, and in many countries anise is included in the pharmacopeias as the official drug. Anise is generally recommended as a carminative, digestive agent and improves the regulation of digestion. Experiments showed that anise, in combination with other plants is a safe and efficient alternative therapy for chronic constipation. Also, it was found that anise increases the secretion of salivary glands leading to an increase of pH in the mouth. Furthermore, it can be used for mechanically rinsing the oral cavity, thereby removing dental plaque. Apart from possessing antibacterial activity, anise is effective in the suppression of bacteria which cause dental caries. Anise fruit extract significantly decreases the gastric acid secretion and acidity and thereby inhibits the formation of ulcers in the stomach. Additionally, it possesses anti-diabetic activity, i.e. anise significantly increases glucose absorption in the small intestine, while having no effect on the amount of the water absorbed from the colon. In addition, anise significantly reduces the diuresis. [12-14]The introduction of anise in the diet ensures that the glucose is available to cells and that water is conserved in the body thus preventing dehydration. In many countries, anise is recommended for the treatment of the respiratory tract. Experiments have shown the bronchodilatory and anti-inflammatory effect of anise, thus confirming its effectiveness in the treatment of bronchial asthma. Also, anise is used throughout the world in the treatment of neurological diseases. Studies have found that the plant works as an antiepileptic and as an analgesic. Anise is a herb that has been used for centuries as an estrogenic agent. In women with symptoms of primary dysmenorrhoea the application of anise leads to a reduction of the bleeding period and menstrual pain. In postmenopausal women it effectively reduces hot flashes. In addition, anise acts preventively on osteoporosis caused by estrogen deficiency as it retains calcium in the bones. By using modern scientific methods it has been found that the reactive oxygen species cause oxidative damage to biomolecules, which as a result form many acute and chronic diseases such as atherosclerosis, cancer, aging, neurodegenerative diseases, diabetes, myocardial infarction, apoplexy, chronic inflammation, etc. Anise shows high antioxidant activity. Furthermore, it can be classified as a food for prevention and treatment of cancer, because it was found to have cytostatic activity on human prostate cancer cells and is safe for normal cells. [15-16]Numerous studies found a wide range of anise effects on microorganisms. It works on bacteria as gram positive and gram-negative, which indicates a high antibacterial potential of this plant, especially if we take into account production costs, availability and efficiency. It can be concluded that the extract is effective and inexpensive alternative to synthetic antibiotics. Additionally, in contrast to synthetic antibiotics, bacteria do not develop resistance to phytochemicals. A large number of fungi on which the anise essential oil has antifungal effects are confirmed. The same effect was observed on viruses such as Herpes simplex virus, cytomegalovirus, measles viruses and amoebas (Entamoebahistolytica) that cause dysentery. All this classifies anise as a functional food against infectious diseases. [17-19]

Traditional benefits of Anise seed products

Anise seed as well its oil has discovered application in several traditional medications because of their exclusive health endorsing as well as disease stopping functions. A concoction of seeds in hot water is used as a carminative, antiseptic, diuretic, digestive and a folk remedy to insomnia and constipation. Furthermore, several therapeutic effects including those on digestive disorders, gynecologic, and also anticonvulsant, anti-asthma and dyspnea have been described for the seeds of Pimpinella anisum. Stir a teaspoon of crushed anise seeds in the cup of boiling water. Steep for Ten minutes. Drink the tea after having a huge meal. Furthermore the tea relax you, anise helps digestion of food, puts a stop to indigestion and contains an anti-flatulence agent. Use the essential oil of anise just as one expectorant. The oil behaves as a decongestant simply by favorably affecting secretory cells within the respiratory system. Anise can also be frequently present in cough syrups as well as cough drops because of its anti-microbial qualities. [17-18] Add anise seeds within sweet foods just like pastries, cakes as well as cookies. The moderate liquorice taste boosts the sweetness. In cooking, mix anise along with cinnamon. Their tastes enhance one another. The fairly sweet, powerful odor attracts fish. Combine anise along with coriander, fennel seed as well as sugared vodka. It seems sensible a fairly sweet liqueur known as anisette. Anise preparations are a fantastic treatment for asthma, bronchitis cough in addition to digestive complaints just like flatulence, bloating, colicky stomach pain, nausea as well as indigestion. The essential oil includes 75 – 90% anethole that has a noticed estrogenic effect. The decoction extracted from the seeds frequently is recommended within the breastfeeding mothers to enhance breast-milk manufacturing. Anise seed water is extremely useful in reducing running nose symptom in babies. The seeds usually are chewed right after a meal in India to invigorate the breath. [19-20]

Culinary uses

Aniseed has similar uses to that of fennel seeds but is a popular option for making sweet dishes such as smoothies, desserts, cookies, cakes and drinks. Anise is the preferred spice used to add liquorice flavour to candy and liqueur. Anise is used widely as a flavouring for dairy products, gelatins, puddings, meats, and candies. Both Fennel seeds and Aniseed spice is used as breath fresheners. Anise seeds, oil and also fresh young foliage is utilized in cooking. The taste is increased by dry-frying the seeds. Anise is utilized in delicious as well as fairly sweet dishes in which it imparts sweet-aromatic taste to number of foods. The entire seeds as well as often-times newly grounded powder included with the recipes in the last moment to restrict the evaporation of essential volatile oils inside them. This sensitive spice is now being utilized as flavoring base for soups, sauces, breads, cakes, biscuits as well as confectionary. Popular aniseed

flavor drinks consist of prenod, frenchpastis, spanishojen etc. Anise seeds along with its oil have been around in use in the preparation of sweet dishes in several Parts of Asia. It is utilized like a flavoring base within the preparation of herbal tea; along with liquor known as anisette. Star anise (bajiao) is probably the most significant spices in Chinese cuisine, and it's also the dominating flavor in Chinese five-spice powder together with cloves, cinnamon, huajiao (Sichuan pepper) and ground fennel seeds. In the food industry, anise is used as flavoring and aromatic agent for fish products, ice cream, sweets, and gums.

Conclusion

Pimpinella anisum is one of the medicinal plants which have been used for different purposes in traditional medicine of Iran. So far, different studies were performed on the extracts and essential oil of *Pimpinella anisum* to identify the chemical compounds and pharmacological properties of this plant, and various properties such as antimicrobial, antifungal, antiviral, antioxidant, and insecticidal effects have been reported of aniseeds. The findings also revealed that aniseeds can cause gastric protection, muscle relaxant, and affect digestive system. In diabetic patients, it has hypoglycemic and hypolipidemic effects and reduces lipid peroxidation. Aniseed also has beneficial effects on dysmenorrhea and menopausal hot flashes in women. The most important compounds of aniseeds essential oil were *trans*-anethole, estragole, *γ*-hymachalen, *p*-anisaldehyde, and methyl chavicol.

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SAVE THE ENVIRONMENT (STE) was founded and registered on 19th November 1990. In 1992 with the collaboration of WWF (India), the organization started working to combat arsenic poisoning problem of water in the arsenic prone areas of West Bengal. Since then STE has been involved in various projects related to combat arsenic problem in India.

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