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LOCAL PERCEPTION OF INDOOR AIR POLLUTION WITH USE OF BIOFUEL IN RURAL COMMUNITIES OF UCHALLI WETLANDS COMPLEX, SALT RANGE PAKISTAN

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ABSTRACT

More than 2.4 billion people around the world in the rural community depend on biomass fuel (wood, charcoal animal dung, and crop residue). Incomplete combustion of this fuel has led to increased amounts of indoor pollution and raise in global warming; this has further led to the increase in the incidence of diseases. Therefore, interventions to reduce biomass fuel related emission by alternative fuels and improved combustion efficiency can improve health, add to socioeconomic development. The area selected for sampling was the Uchalli Wetlands Complex which in the Northwest of Khushab district in Pakistan which houses three saline lakes surrounded by forest and villages. A questionnaire was designed with questions regarding the household fuel use and techniques to improve livelihood and to create awareness and locals from the age of 19-95 were interviewed with a majority of males, houses in the area were mainly of stone blocks and majority males in the area worked in the city. Combined family system was prevalent in the area (80%) with about 42% of the population having no formal education. A wide variety of stoves were observed in the area with wives having a major decision (69%) in fuel choice which mainly depended on the cheapness and availability of the fuel. The cooking being mostly done (79.8%) outside in summers and indoors in winters. Majority of the respondents (94.7%) were aware that liquid petroleum gas and natural gas are better ways of reducing pollution and decreasing the incidence of diseases which included using dry wood, proper ventilation and many others.

INTRODUCTION

Ethno-Environmental study is the study of humans in their vast array of cultures and activities, in relation to nature and the environment with the use of education physical and natural sciences in social and cultural attempts to understand environmental issues. The goal is to consider indigenous perspectives on the ways that humans live and operate in a world that has increasing challenges due to changes and hazards to the environment that supports life.

The term "Ethno" depicts people or ethnic divisions of people is applied to many physical and natural sciences, it also considers public health, political, justice, trade, economics, national and international relation issues Young (2010).

Around the world more than more than one-third of the population relies on biomass fuels (wood, dung, charcoal and crop residues) for their household energy needs (Fullerton et al., 2008). These fuels have been burnt over the centuries when people started cooking and found them as a source that caught fire and acted as fuel for it. Stoves were created later for safer and speedier cooking and according to how each biomass fuel could be utilized. These stoves as not being efficient enough poorly burnt the fuel and people cooking inside the living room in poorly ventilated conditions have been facing major problems that in turn relate to burning of biomass fuels

The smoke resulting from incomplete combustion contains a range of health deteriorating substances that, at varying concentrations, can pose a serious threat to human health, especially women and young children (Fullerton *et al*., 2008). There is sufficient evidence linking smoke from solid fuel use with acute infection of lower respiratory tract, chronic obstructive pulmonary disease and lung cancer (WHO 2008). Mishra and Retherford (2007), reported chronic nutritional deficiencies including anemia and stunted growth in children with constant smoke exposure.

Shrestha and Shrestha (2005).figured out 94% of the population of respondents in Nepal using biomass fuels in which increased the particulate matter in the kitchen three times of those using better fuels life, liquefied petroleum gas and biogas. Ezzati, (2005); Orozco-Levi *et al*., (2006); Smith *et al*., (2004) consider poor combustion of biomass fuel and lesser awareness to decrease ways of pollution being responsible for

obstructive pulmonary heart diseases and related cardiovascular diseases which increases with the particulate air pollution which occurs indoors with burning biomass fuel, this further leads to significant increases in fibrinogen, plasma viscosity, platelet activation and release of endothelins, a family of potent vasoconstrictor molecules Brook *et al*., (2004).

McCracken *et al*., (2007) also reported an increase in the diastolic blood pressure of women in Guatemala, Africa thus proving that biomass fuels aggravate the risk to cardiovascular health and increase the premature death rate due to poorly combusted fuel which makes around 4% of the disease rate in the world. Smith (2002).

Mishra *et al*., (1990) carried out a study on 1532 female patients attending chest clinic, for over a time span of 13 years. The incidence of smoking was found to be 6.6%, maximum incidence (17%) being in those above 60 years of age. High incidence (66%) of exposure to kitchen smoke was observed in women above 40 years of age. Chronic bronchitis was found to be the commonest illness followed by bronchial asthma, pulmonary tuberculosis and bronchiectasis. Bronchial asthma and pulmonary tuberculosis were common in younger age groups, while above the age of 40 years 42% patients had chronic bronchitis and 27% had bronchiectasis.

Mishra *et al*., (2002), worked on the indoor air pollution and risk assessment in rural areas, he found out that majority of the diseases in rural areas are due to malnutrition followed by AIDS, diseases due to poor sanitation and then using biomass fuels including wood, dung, animal refuse, charcoal over long term periods inside homes contribute to the respiratory illnesses including lung cancer, tuberculosis. It even acts as an aggravator to cause blindness mainly observed in women that spent hours cooking and reduction to this exposure by different means like better ventilation and efficient stoves could be related to better health and decrease in the incidence of disease.

Partially successful plans have been observed in the past with disseminating better quality stoves that have reduced fuel consumption thus reducing the exposure to poor combusted fuels. In future much research is required to provide the consumer with health and environment friendly stoves to make their investments worthwhile (Ahuja, 2009).

Incomplete combustion of biomass fuels being a major source of health problems especially for women in the developing world also add significantly to the global warming. Ryan *et al*., (2005) linked the use of biofuels to climate change, the European Union has proposed the use of biofuels instead of fossil fuel to decrease the Greenhouse gas effect from the transport sector as well as by raising awareness amongst the rural community. This would also lead to the cost of subsidizing the price difference between European bioethanol and petrol, and biodiesel and diesel, per ton of CO_2 emissions saved are estimated.

Fisher and Koshland (2007) reported that the humidity in the rural kitchens where biomass fuel is burnt makes a microenvironment of itself which leaves the inhabitants vulnerable to substances causing ill-health, specially the particles like carbon monoxide that stay in the air for large periods of time and could be easily inhaled. Gravitational methods being used over the decades for measuring the particulate matter in homes could now be replaced by the Portable nephelometers being less expensive and less time consuming with better and accurate results.

Biomass fuel use and household energy generation and use is linked to many Millennium Developments Goals and access to cleaner household energy fuels and reduction in indoor air pollution can have significant contributions to achieve many of these goals. In particular, eradicating extreme poverty and hunger (Goal 1), achieving universal primary education (Goal 2), promoting gender equality and empowering women (Goal 3) reducing child mortality (Goal 4), improve maternal health (Goal 5) to opening up opportunities for income generation and eradicating extreme poverty (Goal 1), and to ensuring environmental sustainability (Goal 7). WHO reports the "proportion of the population using solid fuels for cooking" as an indicator for assessing progress towards Goal 7 and integration of principles of sustainable development in countries polices (WHO 2005).

It is recommended that improved quality stoves are used as a cost effective way to reduce the burden of disease associated with exposures to indoor air pollution, the size, placement and ventilation of the kitchen and the height and location of the stove (Mehta and Shahpar, 2004, Dasgupta, *et al.,* 2004a, 2004b).

The present study was conducted at the Uchalli Wetland Complex in Punjab province of Pakistan. Pakistan is the world's sixth most populous country with an estimated population of 173.51 million by 2010 with almost 64 % of the population is living in rural areas (Pakistan economic survey 2009 -10). Being an agricultural country with a majority dwelling in the rural setup where livestock keeping and rearing is thought of as to be a status symbol, enough of dung and vegetable or wheat and rice refuse is available to the people. It not the trees, herbs and shrubs are cut and wood used to burn stoves and also to keep warm in winters at the same time

Recently a review on state of indoor air quality in Pakistan has concluded that although the levels of indoor air pollution are considerably higher due to use of biomass fuels and it had not received much attention due to a lack of awareness among the population and policy makers regarding its association with ill health. (Colbeck et al., 2010)

MATERIAL AND METHOD

Site and study Population: The area selected for sampling was the Uchalli Wetland Complex which is 13km west of Nowshera and 42km Northwest of Khushab. It consists of three brackish to saline lakes namely Uchalli (943ha), Khabbaki (283ha) and Jhalar (100ha). All these lakes are surrounded by shamlat (naturally growing forests). Thus making fire wood easily available to people for use. The population density in the area is almost 139.1per sq km with around 6.2 as the average household size. The majority people live in the combined family system and around 1 person from every household works in the city to fulfill the necessities of life. Houses mainly consist of stone walls and tiled roofs.

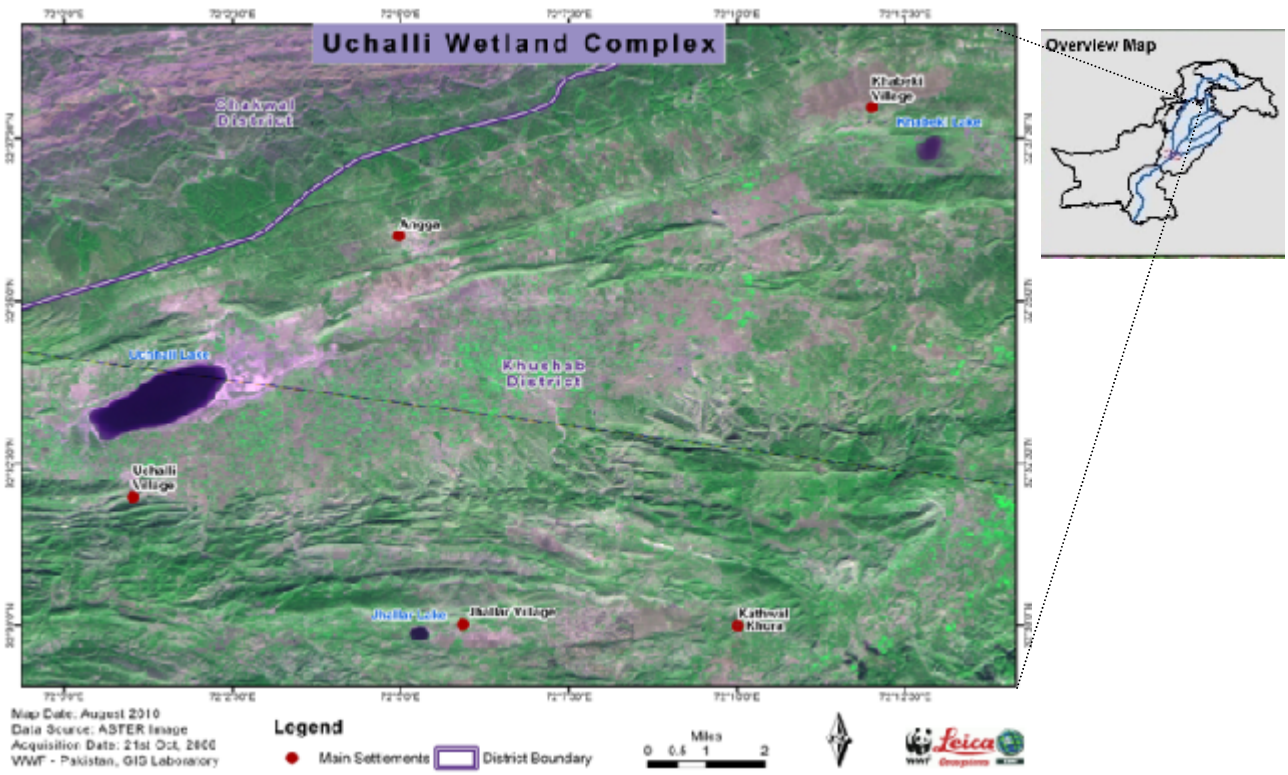

Figure 1: Map of the Study Area

Sampling and Questionnaire: The respondents were recruited from majority of the houses in the area and most of them consisted of males. The data was collected from married couple either husband or wife of mixed ages, range from 19 – 95 years old. A questionnaire was designed particularly for the purpose of this study. Questions were focused on; household characteristics, type of fuel usage and decision in choice, awareness of association between different cooking fuel and general health, awareness and uses of various methods to reduce cooking smoke. Questions regarding the awareness and use of various methods to reduce cooking smoke exposure were adopted from WHO, 2008.

RESULTS AND DISCUSSION

Household characteristics of the participants are in Table 1. Married people of age groups from 19-95 years were questioned. This was done to know perceptions of each age group and how their ideas and thinking differed due to the generation gap. A majority of the participants were males (74%) whereas the remaining 26% being the females. In the study area males were head of household and had greater say in household decision. The women of the area were cooperative when visited in the house. Majority of the houses in the area were built of stones cut into large square blocks cemented on top of each other as these stones were cut from the mountains by the locals and bricks were comparatively difficult to attain locally, 65% of these houses had tiled roofs and the remaining had roofs of wood planks covered with straw or plastered mud. The household size were generally not very large and number of children ranged from 0 –5. Almost 80% of the respondents were living in combined family system as mostly men (92%) in the family left for either working in the cities or had joined the armed forces. Here, separate family system relates to father's

land being divided to all his male heirs who build their own houses and live, earn and work separately Around 42% had no formal education and this class mainly consisted of the old people or the villages that did not house high school for girls and parents would not allow the girls to travel to another village for higher study.

Table 1. Household characteristics of study population

	Mean	Mini.	Maxi.		
Age (Years)	40	19	95		
Number of Children	3.9	0	10		
Gender	Male	Female			
	74%	26%			
Housing type	Tiled roof	Untilled roof			
	65%	35%			
Family System	Combined	Separate			
	80%	20%			
Source of earning	Yes	No			
	92%	8%			
Husband help in cooking	Yes	No			
	10%	90%			
Education	None	Primary	Middle	Secondary	Graduate
	42%	19.8%	8.3%	3.7%	6.2%

Ninety -two percent of the households were using only biomass fuel (wood, dung and crop residue) while eight percent used both biomass fuel and liquefied petroleum gas. A wide range of stoves were being used that did not differ much from one village to the other. In deciding the use of fuel type, wives had a major share (69%) followed by both husband and wife (12%) and husband only (19%). The extensive use of biomass fuel was very likely due to easy and free or cheap availability. A considerable share of wives in household fuel decision is probably their contribution in collection of biomass fuel rather than role in decision to choose household fuel. Women were generally involved in production of dung cake and collection of crop residue. In homes where males decided which fuel to use included the one who do not let the women go for wood collection, these either buy the wood from other people or work in the city and could easily afford LPG. The cost and availability of the fuel stood first and second in choice of the fuel Comfort and health issues could not get any consideration in choosing a household fuel. The role of cost and availability was further highlighted when 80% of the participants mentioned that biomass fuel has some advantages as compare to 9% percent disagreeing mentioning the health problem that aggravated due to the use of these fuels. Cheap and easy availability being the major causes for the specific fuel use. The area being mild hot in summers and cold in winters clearly depicted the households carrying out indoor cooking during winters and outdoors in summer time (79.8%). 7.3% used outdoor kitchen only 1.7 % had a kitchen in the living area both in the summer and winter seasons (Table 2). Different kitchen designs were seen built according to the demand. The outdoor kitchens were not covered but usually placed right outside the living area. Time spent on cooking, varied with the people using Biomass fuel only and the ones using LPG 78% were spending 4 – 5 hours and 12.2 % spent 2 – 3 hours in every day in cooking whereas 9.8% spent almost 6-7 hours in cooking (Table 2).

Table 2. Salient features of household fuel use

	Biomass	Both			
Fuel group	92%	8%			
Fuel type decision	Husband	Wife	Both		
	19%	69%	12%		
Fuel choice rank	1	2	3	4	None
Cost	93%	3.4%	-	-	3.6%
Availability	27%	60%	9.3%	-	3.7%
Environmental Friendliness	-1%	-	-	-	99%
Comfort	-	-	-	-	100%
Health Issues	-	-	-	-	100%
Cooking time	-	-	24%	5.2%	70.8%
Biomass fuel advantages	Yes	No	Do not Know		
	80%	90%	11%		
Cheap	92.8%	7.2%			
Easily available	47.9%	52.1%			
Cooking place	Living area	Indoor Kitchen	Outdoor Kitchen	Winter indoors and summer outdoors	
	1.7%	11.2%	7.3%	79.8%	
Time spent on cooking	< 1 hour	2 – 3 hrs	4-5 hrs	6 – 7 hrs	>7 hrs
	-	12.2%	78%	9.8%	

Awareness of the impact of cooking fuels was observed in a large proportion of the population (82.3%) had knowledge that some fuels are better for health. Natural gas and liquefied petroleum gas (LPG) (82.3%) were identified as best fuels. However wood along with natural gas and LPG was also mentioned as good fuels (10.5%) and only 7.2 % pointed wood as best fuel for the health. In addition a vast majority was aware and agreed that cooking with biomass fuel effect their children health (87.2%). It was fairly noted that both the young and the old preferred Natural gas and LPG as a source of fuel but the old people mainly said that natural gas is not a necessity it's just a luxury to have and even if health issues might decrease with the fuel according to them it would not be a major change in the lifestlye (Table 3).

Table 3. Awareness of health impact of cooking fuel.

	Yes	NO	Do not Know		
Some cooking fuel are better for health?	82.3%	4.6%	13.1%		
Which one are the Best?	Biomass[1]	Clean[2]	Both		
	7.2%	82.3%	10.5%		
Biomass fuel effect you or your children health?	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
	87.2%	7.2%	4%	1.6%	-%

[1] Biomass: Wood, crop residue, dung
[2] Natural gas, and LPG

Awareness among the majority (94.7%) in the area present due to electronic media reaching them through radio, television, and to some even through the internet was present of how to reduce indoor air pollution exposure. The awareness categories that included three parameters were 1. Changing the source of pollution, 2. Improvement in the cooking environment and 3. Modifying the user behavior. Among changing the source of pollution, use of natural gas (50%), LPG (700%) and combination (30%) of fuels were mentioned. In the case of cooking environment improvement, better ventilation (90.2%), use of chimney (72.3%) and kitchen separate from the house (15%) were highlighted. In modifying the user behavior by changing the cooking practice, use of dry fuel (93%) was proposed by the respondents (Table 4).

Table 4. Awareness of various methods to reduce exposure to biomass fuel smoke

Awareness of any method to reduce smoke during cooking	Yes	No
	94.7%	5.3%
Changing the source of pollution (Yes, NO, NA)	Improving the cooking environment(Yes, NO, NA)	Modifying user 433behavior (Yes, NO, NA)
Improved Stoves	Stoves with chimneys	Fuel drying
10,80,10	72.3,20.5,7.2	93,5,2
Alternative /combination of fuels	Improved ventilation	Good maintenance of stoves and chimneys and other appliances
30,60,10	90.2,5.4,4.4	0,80,20
Liquefied petroleum gas	Kitchen separate from house reduces	Reductions by avoiding smoke
70,10,20	exposure of family	•Keeping children away from smoke
	15,65,20	62,17,21
Natural gas	Kitchen design and placement	
50,40,10	of the stove	
	20,80	
Biogas	Stove at waist height reduces direct	
0,100,0	exposure of cook leaning over fire	
	0,80,20	

Table 5. Use of various methods to reduce exposure to biomass fuel smoke

Changing the source of pollution (Yes, NO, NA)	Improving the cooking environment (Yes, NO, NA)	Modifying user behavior (Yes, NO, NA)
Improved Stoves	Stoves with chimneys	Fuel drying
10,80,10	52,44.7,3.3	77.8,20.6,1.6
Alternative /combination of fuels	Improved ventilation	Good maintenance of stoves and chimneys and other appliances
15.2,71.9,12.9	87.9,7.7,4.4	0,99.2,1
Liquefied petroleum gas	Kitchen separate from house reduces	Reductions by avoiding smoke
7.9,86.5,5.6	exposure of family	•Keeping children away from smoke
	15,65,20	039,50.5,10.5
Natural gas	Kitchen design and placement	
3.1,95.2,1.7	of the stove 10,82.8,7.2	
Biogas	Stove at waist height reduces direct	
0,98.7,1.3	exposure of cook leaning over fire	
	0,100,0	

As for method used in changing the pollution source, combination of LPG with biomass fuels (15.2%) was used. Improved ventilation (87.9%) and chimney (52%) along with kitchen design and placement of stove (10%) were used with improvement in the position, and environment of the kitchen, dry fuel use (77.8%) was mentioned by all the participants (Table 5).

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