

# **SOCIAL IMPACT OF HIGH INCIDENCE OF KIDNEY STONE**

## **A Study of Coastal Villages in Junagadh, Gujarat**

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### **ABSTRACT**

*In about thousand villages in coastal Saurashtra (Gujarat) the TDS levels have risen beyond 2,000 ppm (throughout the year) due to seawater intrusion and excessive groundwater extraction. They have been termed as fully saline villages. In Junagadh district of Saurashtra, intrusion of seawater has increased from 3 to 12 kms during the last three decades and more than 130 thousand hectares (about 15 percent) of the total area of Junagadh are affected by salinity. In 2006, Aga Khan Rural Support Programme (India), working for the last fourteen years in Mangrol taluka of Junagadh district, recognised 25 villages as fully saline of the total 63 villages.*

*Seawater intrusion has changed the water quality in Junagadh contaminating it with excess salinity and different elements such as chloride, calcium, magnesium and sodium. This has led to prevalence of several health hazards in the region namely kidney stones, hypertension and skin diseases; urologists of Junagadh estimate that about 6 percent of district population suffers from kidney stones. Medical practitioners say that etiology (the study of the causes of diseases) of ailments such as hypertension, skin diseases and kidney stone include many aspects and not just increase in salinity. One of the major reasons for kidney stones, however, is the high concentration of calcium in drinking water. A report of chemical analysis of 119 kidney stones prepared by an urologist in Junagadh showed that 41 percent and 48 percent of those had calcium-oxalate of degree-3 and degree-2 respectively, which explains the presence of excess calcium in the body. The same urologist reported to have attended 115 Lithotripsy (an ultrasonic procedure of breaking kidney stones) cases in the last year in addition to other general operative and medically cured cases of kidney stones. What needs to be noted is that this was an experience of a single urologist. A detailed compilation of reports from the Govt Department of Urology and other clinics of Junagadh may provide a much more alarming picture. The study aims to estimate the prevalence of kidney stones in the region and understand its varied socio-economic impacts - expenses incurred in treatment, expenses incurred in procuring good quality water and loss in wages due to inability to work.*

*Based on a discussion with some urologists, five leading symptoms were identified to estimate the prevalence of kidney stone in the five selected study villages of saline area of Mangrol taluka and two control villages from non-saline area of Maliya taluka. A census of these villages revealed that 7.9 percent of the population in fully saline villages and 3.2 percent in non-saline villages had at least one of the five symptoms. The combination of two key symptoms (signifying a definite presence of Kidney stones) was found among 4.4 percent population of the saline villages and 2.0 percent in the non-saline villages. The average amount of TDS and Calcium found in saline villages was 2,462 mg/litre and 296 mg/litre respectively, far beyond the maximum permissible limits prescribed by ISI (500 mg/litre for TDS and 75 mg/litre for*

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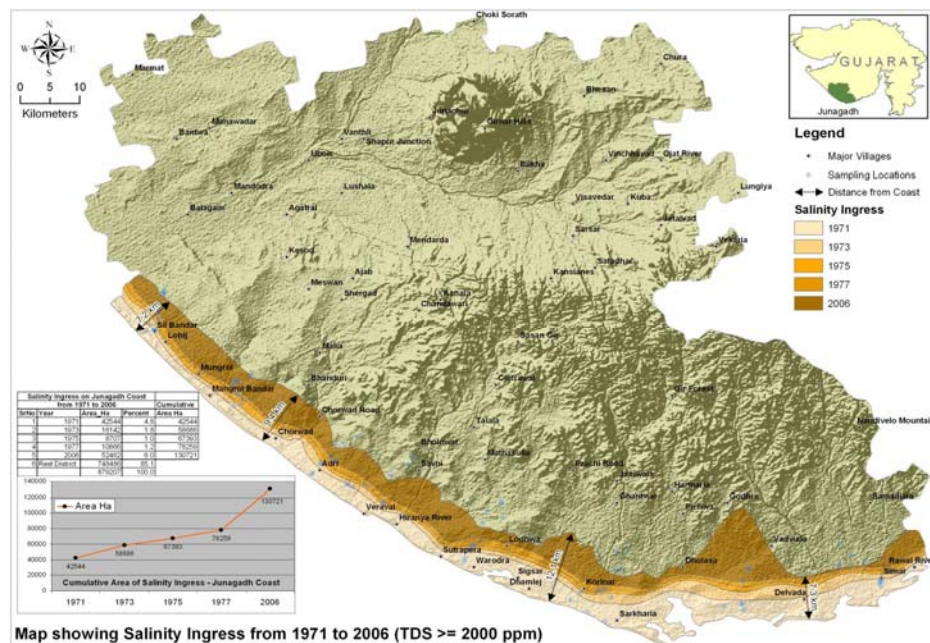
Calcium). The corresponding figures in non-saline villages were 345 mg/litre and 52 mg/litre respectively. In the saline villages, the average treatment expense incurred by an affected person was Rs 5,790 and average wage loss was Rs 3,520. Urologists say that about 80 percent of kidney stone cases have a chance of recurrence, raising the expenses incurred on treatment even further. Given its high social costs, the problem of kidney stones, thus, deserves immediate attention from concerned authorities.

**Key Words:** Salinity, Kidney Stone, Medical Expenses, Wage Loss and Drinking Water Expenses

## 1. INTRODUCTION

Gujarat has the longest coastline of 1600 kms amongst all Indian states. About thousand villages in Saurashtra area located in this coastline have more than 2000 ppm of TDS throughout the year due to seawater intrusion and excessive groundwater extraction. In the High Level Committee Report of 1977 it is said that 120 villages of Junagadh district were affected by high salinity. It also said that more than 2.8 lakh population and about 1lakh hectares of cultivable land in Junagadh were affected. The extent of salinity ingress was found from 2.5 to 7.5 kms inside the coastline (High Level Committee Report (HLC -1), 1978, 17). In a recent study undertaken by IWMI-Tata Water Policy Programme, it was found that the salinity ingress increased up to 12.5 kms with an average of 8.25 kms inside the land from the seashore during the last three decades in Junagadh district (Raychoudhury and Krishnan, 2006). This has affected more than 1 lakh 30 thousand hectares (about 15%) of the total area. The Aga Khan Rural Support Programme (India) working for the last fourteen years in Mangrol taluka of Junagadh has recognised 25 of 63 villages as fully saline in 2006. The salinity programme of AKRSP(I) is operational in 65 villages total of Mangrol, Veraval, Maliya and Keshod blocks of Junagadh district.

The problem of salinity in the coastal region has created a very adverse condition in respect of drinking water supply and other aspects in the lives of the people. The spread of salinity has caused social hardships and several negative externalities such as decrease in farm production, decrease in crop productivity, shifting of labour from agriculture, income inequality, health impacts and non-sustainability of secondary and tertiary sectors.



Much has been done to study the problem of salinity in terms of individual research efforts and Government efforts by way of appointing High Level Commission, or Khar Land Development Board. Institute such as the Central Salt and Marine Chemicals Research Institute at Bhavnagar is also engaged in this endeavour. Their main focus was on the genesis of salinity problems. Moreover, the efforts were also made at different times either to study the specific salinity condition or assessment of some segments of the coastal region. However, the impact of salinity on human health and on socio-economic aspects in coastal region has not been documented yet. The impact assessment of coastal salinity on the livelihoods of the people and coping strategies may provide proper perspective which might be useful to formulate an efficient management plan to bear with the menace of salinity on health in coastal region.

Seawater intrusion has changed the groundwater quality in Junagadh contaminating with excess salinity with very high Total Dissolved Solids (TDS). Consumption and irrigation with this poor quality water can cause variety of suffering towards human and cattle health and also can reduce the output of agriculture. The high sodium in seawater ingress may cause hypertension too. There are typical kinds of skin diseases found among the people who are exposed to high salinity water for a long time. Most significant health hazard in the salinity ingress area is kidney stone, which generally takes place due to high calcium, and magnesium available in saline water besides other reasons. Urologists of Junagadh estimate about 6% of the population in the district are suffering from kidney stones. Five years ago there was no urologist practicing in Junagadh, now there are two private practitioners in the city and a few more in other hospitals. Medical practitioners say that etiology of ailments such as hypertension, skin diseases and kidney stone include many aspects other than only salinity. Therefore it is not always easy to establish salinity as the only cause for all these three kinds of ailments. Though there are other environmental and social reasons like extreme climate, less rainfall, more perspiration and life style of the people, local doctors say that one of the most important reasons for kidney stone in Junagadh is the presence of high amount of calcium and TDS in the water used for consumption. These health hazards due to environmental reasons have impact on the total development of an area because 'good health is one of the most precious assets of any population, but it is particularly important for populations that are poor and vulnerable.' (Woodward, Alistair et al, 2000). Woodward noted further that "when 'bread-winners' suffers serious ill health or injury, entire households can suffer, not only because of loss of income but also as a consequence of the high direct cost of medical care, a common cause of impoverishment in itself". Thus the weak health of human resource will be a hurdle to the society for entire development of a region.

## **2. RESEARCH OBJECTIVES AND METHODOLOGY**

The study, therefore, tried to focus on the social impact of high salinity, particularly on expenses on medical care for the incidence of kidney stones in the populace. Focus was to understand the prevalence of the kidney stone, medical expenses for it, loss in wages due to inability to work and expenses on good quality water. Understanding that cases of hypertension and skin diseases requires a long-time history of patients and can be attributed to several other causes we did not focus on those health ailments. Therefore our objectives are as follows:

### **2.1 Objectives**

1. To estimate the prevalence of the kidney stone ailments
2. Expenses on medical treatment for kidney stone

3. Loss in wages due to inability to work for kidney stone, and
4. Expenses on good quality water to avoid the vulnerability of health

## **2.2 Methodology**

Step 1: A census survey was conducted in 5 study villages from the fully saline area of Mangrol taluka and 2 control villages from non-saline area of Maliya taluka to estimate the prevalence of kidney stone cases using five most important symptoms based on the discussion with consulting urologists. A structured questionnaire has been used as tools that includes basic details of each member of a household such as name, sex, age, education, years or stay in village along with 5 most important leading symptoms of kidney stone and expenses on water.

Step 2: Since there is no benchmark data for this study, we selected villages from the area where AKRSP(I) has intervention since the last ten years or more. They are working in 40 of 63 villages of Mangrol taluka. The study villages were selected from Mangrol taluka on the basis of high salinity using data-base of AKRSP(I) and control villages from Maliya taluka on the basis of no-salinity.

Step 3: Taking into account the prevalence of kidney stone cases from the census data we selected a sample of 156 households with 176 afflicted persons for a detail study of tangential expenses explained above from both study and control villages. Her also we have used a structured questionnaire for collecting family details of the afflicted persons, details of medical expenses including the expenses of the accompanied person/s stayed with the patient during hospitalisation, wage loss of the patient due to inability to work for his ailment and the accompanied person/s as well for attending the patient, etc.

Step 4: About 25 afflicted persons – 20 from saline villages, and 5 from non-saline villages were selected from the sample households of both the areas for pathological and other clinical tests by a professional urologist. They had regular blood, urine test, x-ray and ultra-sonography tests for understanding the salinity related causes of kidney stones.

## **3. SELECTING STUDY LOCATION**

We had several discussions regarding kidney stone occurrence with local urologists, doctors of Health Centres and Civil Hospitals; and collected the most significant five questions from them. We also scrutinized the village-wise water quality of the past years for judicious selection of high saline and non-saline villages. The five study villages were selected from fully saline villages of Mangrol taluka of Junagadh district where AKRSP(I) has intervention. The two control villages were selected non-saline villages of Maliya taluka of the same district. Mangrol has 25 fully saline villages of the total 63 villages and Maliya has only 3 fully saline villages of the total 52 Villages.

### **3.1 Junagadh, Mangrol, Malyia and Selected Villages**

The district has a population of 24,48,173 (District Census 2001) in 4,32,884 households. The rural population is 17,36,645, which is 70.9% of the total population. The population of Mangrol taluka is 1,89,053 of which 70.2% is rural. Maliya has 1,44,975 population with 85.4% staying in

rural area. The district has annual rainfall between 800 to 1000 mm and the temperature varies from 5 to 46 degree Celsius.

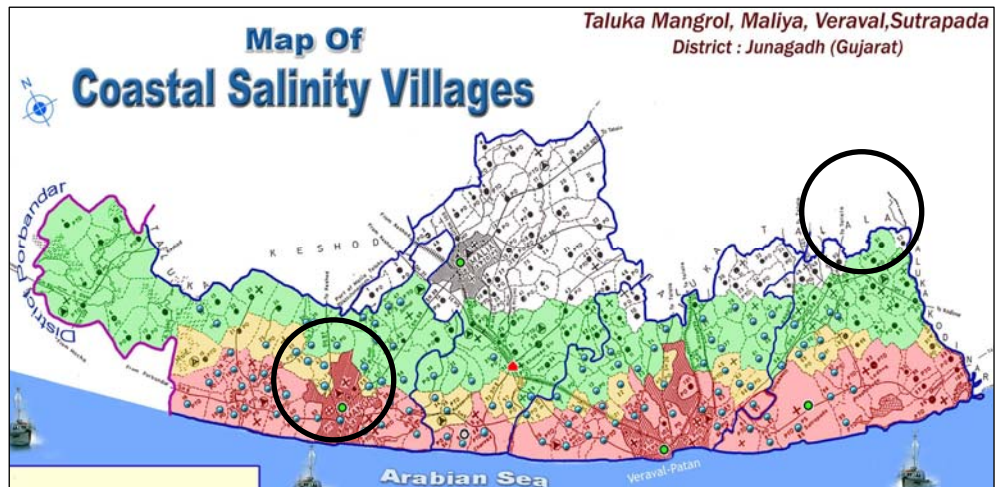
The five study villages are from Mangrol namely, Husseinabad, Sheriayaz, Shil, Talodra and Zariyavada. The households and the population of these villages according to 2001 census are: Husseinabad (358) 2745, Sheriayaz (578) 4247, Shil (1206) 6539, Talodra (255) 1506 and Zariyavada (377) 2195 (figures in the parentheses are the number of households in the villages). These fully saline villages are situated between 0 to 9 kms from the seashore (see Map). For example, Shil is right on shore i.e. 0 km. and Zariyavada is at about 9 km from the seashore .

The two control non-saline villages are from Maliya namely, Ambalgadh and Tarsingra. The households and population of these two villages are: Ambalgadh (243) 1238 and Tarsingra (226) 1206 (figures in the parentheses are the number of households in the villages). Among the non-saline villages Ambalgadh is located about 25 kms and Tarshingda is about 28 km away from seashore.

### 3.2 Profile of Villages Affected by Salinity Ingress in Mangrol

The coastal belt from Prachi to Mangrol of Junagadh has long been famous as “Lilly Nagher” because of the luxuriant growth of vegetables, fruit gardens and other high value crops. Ground water has been the main source of irrigation in this area. There are no surface water reservoirs except few tanks and check-dams. With advances in agricultural techniques people switched over from

conventional techniques of lifting water with Mhot, to pumping sets. The electrification of rural areas gave further impetus to pumping of ground water with the help of electric motors.



‘The amount of water lifted from the coastal aquifers between any two monsoons increased over 10-15 times’ (Shah, 1993, 154). As the water levels fell, the wells were deepened in order to increase supply of water or continue getting the same quantum of yields. ‘A third of Husseinabad’s wells located on fields closer to sea became saline. ... all water pump from these wells now is unfit for irrigation’ (Shah, 1993, 166). The crop yield was affected. Price of Coconut fell down to half or more than half as the size of the fruit shrunk. Also, the yield of coconut dropped to about one third. Easy availability of institutional finance, the large number of wells, pumping sets and electric motors facilitated this process at a phenomenal pace leading to excessive withdrawal of ground water. However, this was not accompanied by creation of corresponding recharge facilities. This has led to rapid deterioration of quality of ground water on account of seawater intrusion in this area. In addition, the tidal water, which travels upstream along river channels,

has not only contaminated surface water but also affected the quality of ground water due to percolation.

### **3.3 Observations on Current Situation**

1. The geological formation of all the five villages chosen as affected villages is the Gaj bed, which is highly porous limestone. With the extraction of water the seawater intrusion takes place in such geology. The well depth in these villages is restricted to 40-50 feet, beyond which saline water would be there.
2. The well digging has decreased with the area coming under dark zone. In this zone subsidies are not available for digging a well. Still almost 25 new wells are dug every year in Shil! Currently there would be around 800 wells approximately with around total 600 landholders in Shil.
3. In Talodra around 300-350 wells are there with an increase of 10-15 wells a year. Similarly Zariyavada has 200 to 225 wells. Sheriyaz has smaller landholding hence more wells i.e. around 300 and Husseinabad has about 225 wells currently.
4. The coastal areas of Junagadh were known for its orchards. Nawab of Junagadh first planted the famous 'kesar' mango in the village of Husseinabad. But, as it is a very sensitive to salinity, now very few mango plants are seen in this village!
5. The labour available locally in saline villages of Mangrol is for maximum up to 120 days. In almost one-third of these saline villages, the employment availability is as low as only 90 days even in a good monsoon year.
6. Due to increase in family fragmentation, the land is divided to small pieces and the current land holding is so small that it does not support the households. More than 50% of households have below 2 hectares of land.
7. Diamond polishing in Bhavnagar district is one prominent option in which many members of the coastal farming community are adopting as occupation. It is observed that at least one member of almost 30 per cent of the families of Shil village have migrated to Bhavnagar for diamond cutting work and also to Junagadh in search other employment.
8. Due to salinity in water, Rabi crop cannot be grown. The landowners of the villages with severe seawater intrusion have become agricultural labourers. They look for agri-labour work on daily basis in neighbouring villages with better water. Village Sheriyaz is one such example, once very fertile with orchards now has turned into a desert. Almost 3000 men and women have migrated to Antroli village, which is not saline.
9. From all the five saline villages the better off communities such as Patels have migrated from saline zones long back. Communities like Patels, Lohanas and Kshatriyas have bought land in inland villages, and eventually are settling there. Today the population in these coastal villages largely consists of Ahirs, Kolis, Vagharis, Rabaris and Dalits.

10. At the end along with farm pattern, the social structure of villages changed due to prolong salinity. This has changed the economic activities and people's livelihood.

### 3.4 Profile of Villages Not Affected by Salinity Ingress in Maliya

Ambalgadh and Tarsingra are comparatively prosperous villages. The population largely consists of Patels, Ismailis, Rajputs, Rabaris, Dalits, etc.

The geology is of basalt; hence water can be recharged and used. Meghal River is flowing through these villages; water recharge measures are effective here. The geology here have dykes, which are good for recharge structures, and communities have used this potential to harness more water. There are few organizations, which are working here for the benefit of communities since many years. The Ismaili Jamat has done considerable work for health and education in these villages. The education of girl child and higher education of youth has improved due to their presence.

As Ambalgadh is in command area of Chandravadi dam, the water table has improved since the completion of the scheme in 1996. There are about 100 wells in this village. Since the deeper wells can yield better, over the years the depth of wells have increased from 70 to 100 feet .

## 4. CENSUS SURVEY – PREVALENCE OF KIDNEY AILMENTS

A census study was undertaken to understand the prevalence of kidney stone ailments in the above-mentioned selected seven villages. There are some differences found in the total number of households and populations of these villages compare to the census report of 2001 of Government of India. The reasons are obvious such as some households were not found during our survey, some families have been divided in to several numbers since 2001, some might have migrated temporarily or for a long time.

Based on discussion with several urologists, we have selected most important primary symptoms for kidney stones, which are as under:

1. Do you get pain from loin to groin? (Annexure – 1, Figure – 4)
2. Do you feel any burning when passing urine?
3. Have you ever passed blood in your urine?
4. Does urination stop in midstream for pain?
5. Have you passed sand like granules with urine?

**Table – 1: Prevalence of Kidney Stone Symptoms in Saline Non-Saline Villages**

Saline Villages	HHs	Population	% of afflicted population of the total with at least 1 of the sym of 5 symptoms	% of afflicted population of the total with sym 1 and 5 both	% of Total Population Obtain Medical Care	Av TDS in Village	Av Calcium in Village
Husseinabad	323	2394	8.8	4.8	4.3	2067	241

Sheriyaz	596	3005	4.0	2.9	1.7	1568	186
Shil	1561	5255	8.9	4.5	2.6	2831	139
Talodra	275	1298	12.1	4.9	2.2	4182	428
Zariyavala	211	1836	7.7	5.6	4.8	4935	505
<b>Total</b>	<b>2966</b>	<b>13788</b>	<b>1094</b>	<b>604</b>	<b>407</b>	<b>3462</b>	<b>296</b>
% to Total Pop		<b>100.0</b>	<b>7.9</b>	<b>4.4</b>	<b>2.9</b>		
<b>Non-Saline Villages</b>							
Ambalgadh	207	1113	4.6	3.2	1.4	518	78
Talshingada	195	945	1.5	0.6	0.4	448	62
<b>Total</b>	<b>402</b>	<b>2158</b>	<b>65</b>	<b>42</b>	<b>20</b>	<b>346</b>	<b>52</b>
% to Total Pop		<b>100.0</b>	<b>3.0</b>	<b>1.9</b>	<b>0.9</b>		

Source: Field Data

#### 4.1 Prevalence of Kidney Stone Symptoms

All these five symptoms are the leading symptoms for diagnosing kidney stones or urinary calculi. However, among these five symptoms, if a person has both symptoms 1 and 5 then he/she would be much sure of suffering from stone formation in kidney or anywhere in the urinary system. Kidney stone problem or the problem of urinary calculi develops over a time depending on the person's metabolism, food habits, water intake, sweating, life style, climatic conditions around him/her and other environmental factors including water quality. The presence of more number of symptoms does not lead to prove the 'severity of salinity impact' as urologists say that even one or two symptoms can be so severe at times that the patient may have to go for immediate surgery or intensive medical care.

We have interviewed 2966 HHs (Households) that has 13,788 population in five saline villages. The villages have differences in their progress and poverty, however, the water quality criteria remains more or less similar among these villages (Table 1). Average TDS in these villages was 3462 and average calcium was 296, whereas in the two control villages the corresponding figures are 346 and 52 respectively. Indian Standard Institute confirmed permissible TDS as 500 mg/litre and Calcium as 75 mg/litre whereas WHO say that TDS should be nil and Calcium should be 50 mg/litre for drinking water. Of the total population in the saline villages 7.9 % people have at least one of the five symptoms of kidney stones (or urinary calculi) and 4.4 % people have both the symptoms 1 and 5. This means more than 4 % people are suffering from calculi problem in saline villages. A contrasting picture is found in the controlled villages, where 3 % are having at least one of the five symptoms and 1.9 % people are having both the 1 and 5 symptoms. These two facts probably indicate that people living in the saline villages are more prone towards kidney stone problems. However, there are variations in prevalence among the saline villages (Table – 1).

It is found that only 2.9 % of the total population or 37% (407 of 1094 afflicted persons) of the total afflicted persons of the saline villages have taken some kind of medical care (Table – 1).

Among the total population of 13788 in our census there are 7239 males and 6549 females. It is found that 72 % males have at least one symptom of urinary calculi and that of female it is 28 %. Again, 66 % of males have symptoms 1 and 5 both, whereas only 34 % females are suffering with symptoms 1 and 5. Urologists do say that males are more prone to kidney stones and it is

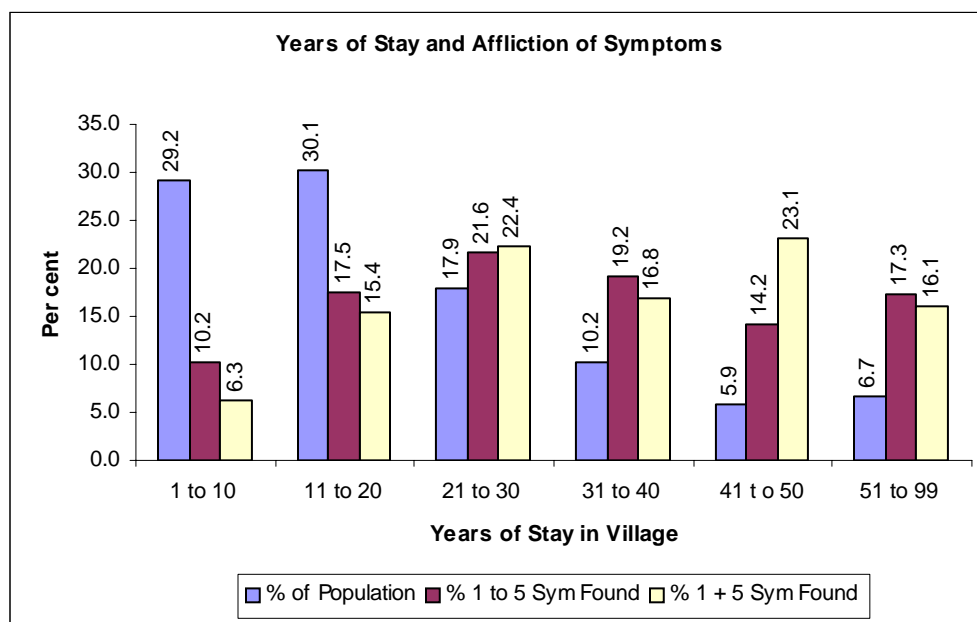


found also that the afflictions are more among men. We found a few cases of juvenile kidney stone also.

#### 4.2 Years of Stay and Affliction

There was an opinion that staying in a saline village for longer time one might be suffering from kidney stone. So we checked with the years of stay in village and affliction of symptoms among the total population of villages. In the Chart –1, about 60% people who have stayed for the last 20 years in saline villages, about 28% of them are afflicted by at least one of the vital symptoms of urinary calculi and about 23% of them have reported for kidney stone as they have symptoms 1 and 5 both. Worst is the case when people stay more than 40 to 50 years in those saline villages, 23% are suffering from severe affliction from 6% population in this time range. The data suggests that if the stay is over ten years in saline villages, the prevalence increases significantly.

**Chart – 1: Years of Stay in Saline Villages and Affliction of Symptoms**



Source: Field Data

This is the prevalence of kidney stones scenario in Mangrol and Maliya taluka. We now go for detail study of these afflicted persons to understand their socio-economic situations, medical expenses and wage loss etc. However before going to the detail study, let us add a few paragraphs regarding Kidney and kidney stone. This may help us to understand the complexity of the kidney and its stone. [Interested reader can see Annexure – 2 for more details.]

## 5. KIDNEYS AND KIDNEY STONE

### 5.1 What are Kidneys and How do They Work?

The kidneys are vital organs that perform many functions to keep our blood clean and chemically balanced. The kidneys are two bean-shaped organs about the size of a fist. They are located at

the bottom of the rib cage at the back of the body, just above the waist, on either side of the vertebral column (Annexure – 1, Figure – 1). A kidney smaller than 9 cms on ultrasound is usually abnormal (Muljibhai Patel Urology Hospital, Nadiad, Gujarat). The kidneys are sophisticated reprocessing machines. Every day, our kidneys process about 200 quarts of blood to sift out about 2 quarts of waste products and extra water. The waste and extra water become urine, which flows to our bladder through tubes called ureters. The wastes in our blood come from the normal breakdown of active tissues and from the food we eat. Our body uses the food for energy and self-repairs.

If our kidneys did not remove these wastes, the wastes would build up in the blood and damage our body. The actual filtering occurs in tiny units inside our kidneys called nephrons. Every kidney has about a million nephrons. In the nephron, a glomerulus—which is a tiny blood vessel, or capillary—intertwines with a tiny urine-collecting tube called a tubule. A complicated chemical exchange takes place, as waste materials and water leave our blood and enter our urinary system. At first, the tubules receive a combination of waste materials and chemicals that our body can still use. Our kidneys measure out chemicals like sodium, phosphorus, and potassium and release them back to the blood to return to the body. In this way, our kidneys regulate the body's level of these substances. The right balance is necessary for life, but excess levels can be harmful (NIH Publication No. 06-4241, November 2005). Its function is to filter blood in the body and clear it from poisons. It is also responsible for excreting the end products of the body's metabolism in the form of urine, which is eliminated from the body during urination (site: [www. CardioGenetics.org/glossary.asp](http://www.CardioGenetics.org/glossary.asp)). Urine, produced by the nephrons, travels downwards from the kidney through small tubes called **ureters** (Annexure – 1, Figure – 2) to collect in the urinary bladder. Each kidney is made up of millions of tiny filtering units called **nephrons** (Annexure – 1, Figure – 3). From the bladder, the urine passes out of the body through the ureter.

## 5.2 Kidney Stone and Its Causes

A kidney stone is a hard mass developed from crystals that separate from the urine and build up on the inner surfaces of the kidney. Normally, urine contains chemicals that prevent or inhibit the crystals from forming. These inhibitors do not seem to work for everyone, however, some people form stones than others. If the crystals remain tiny enough, they will travel through the urinary tract and pass out of the body in the urine without being noticed. Kidney stones may contain various combinations of chemicals. The most common type of stone contains calcium in combination with either oxalate or phosphate. (<http://kidney.niddk.nih.gov/kudiseases/pubs/stonesadults/index.htm>). Doctors also use terms that describe the location of the stone in the urinary tract. For example, a ureteral stone (or ureterolithiasis) is a kidney stone found in the ureter. To keep things simple, however, the term "kidney stones" is used throughout this text.

The first ever history of urinary stones have afflicted humankind since antiquity. The earliest recorded example of bladder and kidney stones detected in Egyptian mummies dated 2488 B.C. (Mani Menon et al, 2002, p. 2262). Till 1980s urinary stones were a major health problem. Over the decades, development in medical sciences and introduction of endoscopic surgery, this major health problem has changed only to a major inconvenience. The procedure of surgery or the treatment of kidney stone could not prevent them from the reoccurrence. Treating urinary

lithiasis requires good understanding of all aspects of its etiology, good diagnosis, medical and surgical treatment.

Referring Mani Menon et al., urinary lithiasis has a sex bias towards male and also towards age. They say that the majority of the patient report at onset of diseases in their teens. They also say that about three adult males are afflicted for every adult female – we also found in our census data mentioned above. This is because of high level of male hormone present among adult men. ‘Women excrete more citrate and have lower incidence of stone formation than men’ (Parmar, 2004).

Epidemiology (the scientific study of the causes, distribution, and control of disease in populations) says that the presence of kidney stones (calculi) in the kidney (nephrolithiasis) varies according to the geographical area and socio – economic conditions. Nephrolithiasis may be associated with renal insufficiency. A study done in Karachi showed that 3% of the population had silent stones. All the stone bearers were male. Most of the silent stones occurred in the left kidney. (Kiersten Brazier – 2001, National Kidney Foundation ([www.kidney.org](http://www.kidney.org))). A study was done in the tribal population of India to find out the association between the Fluoride and urolithiasis in humans. The results showed that fluoride may behave as a mild promoter of urinary stone formation by the excretion of insoluble calcium fluoride, increasing the oxalate excretion and mildly increasing the oxidative burden. A seasonal variation is also seen, with high urinary calcium oxalate saturation in men during summer and in women during early winter. This is also observed in Junagadh district in Gujarat. The peak age of kidney stone found in men is 30 years and women with peak age between 35 and 55 years. Once a kidney stone forms, the probability that a second stone will form within five to seven years is approximately 50% (Kiersten Brazier – (2001). This is also found in our Junagadh study.

Medical evaluation of kidney stone is a complex task. The causes of urinary calculi are multiple. It is further difficult to identify one basic cause for stone. A detail chemical culture of the operated stones or the stone particles collected from the lithotripsy (an ultrasonic procedure of breaking kidney stones called lithotripsy) can give an idea of the composition of the stone. A large number samples tested chemically can help to establish some proven cause for this ailment along with other environmental details and human habits that can lead to prove whether this urinary calculi is due to geographical reason or due to high TDS and high calcium content in the drinking water.

## **6. MEDICAL EXPENSES AND WAGE LOSS**

### **6.1 Selecting Patients**

We carefully selected the patients from the census list after estimating the prevalence of symptoms 1 and 5 both (we are referring the symptoms by numbers given in section – 4 above) and a few of them are with combination of all symptoms, 1 to 5. First we preferred to select from the cases with both the symptoms (1 and 5) because this combination signifies a definite presence of kidney stones and then from the mix of other symptoms taking prevalence in to account. A number of cases have been dropped, as those cases were not having the symptoms concerning stone. Many people complained during census survey about their pains related to urinary stone understanding that they may get some benefits from the government. Actually those complaints of symptoms regarding pain were of other reasons, like urinary tract infection

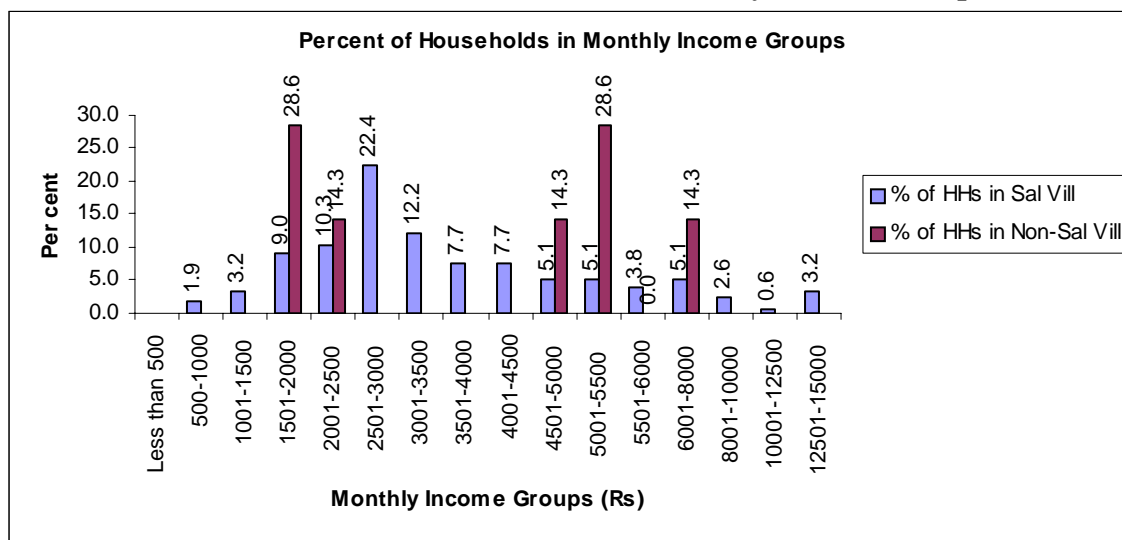
or enlargement of prostrate glands. Those cases were filtered for the benefit of our study. Thus we selected 156 households with kidney stone cases; this is a little more than 5% household of the total census households. Some households have two patients, so we have total 176 patients with stone-related complaints. This means that there is more than one patient in a household. From the non- saline villages we selected 7 households, which is 1.7% of the total households in two non-saline control villages and they have 7 patients only.

## **6.2 Selected Families of Saline and Non-Saline Villages**

These 156 households have population of 1106 with 584 men and 522 women in saline area villages. The 7 households of non-saline villages have population of 34 with 17 men and 17 women. The families were selected on the basis of afflicted persons and not on basis of economic status or social class. However, while surveying we found larger number of families of saline villages is clustered in the lower monthly income groups 59% (Rs 500-3500) compare to the families of non-saline villages where nearly 57% are in higher monthly income groups (Rs 4501-8000) (Chart – 2). The families of non-saline villages have higher income, due to obvious reason that they do not face the environmental hazard like salinity in their village. They have higher agricultural income in non-saline villages, as the salinity has not spoiled it, as in the saline villages. The families from these non-saline villages do not have to buy water from out side when the families of saline villages have to buy water during the last 4 or 5 months of the year even they have tanks for Roof Rain Water Harvesting Systems (RRWHS).

Among the five villages of Mangrol, the households of Shil village buy the least amount of water, because the village has good number of drinking water wells than other villages of saline area. The drinking water quality of these villages is very much saline - TDS is more than 3000 mg/litre and the Calcium is nearly 300 mg/litre (Table – 1). The RRWH scheme started in 1995 in several talukas of Junagadh districts by different NGOs like AKRSP(I), Sarvodaya Trust and GWSSB. It is found from the record supplied by AKRSP(I) that there are 426 Tanks among 5440 households of 7 villages in Maliya taluka till 2006, the coverage is 7.8%; in Mangrol there are 2146 Tanks among 8434 households of 26 villages covering 25.4%. Additionally there are RRWH built by institutions other than AKRSP (I). We have come across that the saline village people are mainly from the lower rung of the social class against the non-saline villages, where we found many families from upper social class. This is obvious because upper class people left villages for high salinity in these villages and settled in sweet water areas, which we mentioned earlier. More than 60% families of saline villages are habituated of taking non-vegetarian foods.

**Chart –2: Percent of Households in Monthly Income Groups**



Source: Field Data

### 6.3 Medical Expenses for Kidney Stone Ailments

It is true that the stones in kidneys do not form overnight or by couple of months. However there are exceptions. People do not visit doctors for initial pains rather they take “grandmother’s remedy” initially. Pain does not occur at the initial stage especially if the stone is located inside the kidney. However if the stone is in the ureter, the duct carrying urine to the bladder, there will be pain signal in the area shown in Annexure – 1, Figure – 4, people go to visit doctors or Ayurveds at this stage. The medical bills start from this stage. We have investigated these bills and collected expenses on pre-operative and post-operative expenses. The expenses includes – operation fees, hospital-stay fees, medicine expenses during operation, pre and post operation medicine expenses, transport expenses from village to hospital and expenses of stay for

**Table – 2: Income, Medical Expenses and Wage Loss**

Source: Field Data

accompanied person/s and also their loss of wages, if any. We have collected these bills as much details as possible from the patients irrespective where they have been treated - homeopaths, Ayurveds or allopathic doctors. Although the medicine costs do not vary much between two shops, but the doctor’s fee, expenses in hospital-stay, fees for general surgical operations, Lithotripsy, x-ray and ultra-sonography do vary across doctors, hospital and cities.

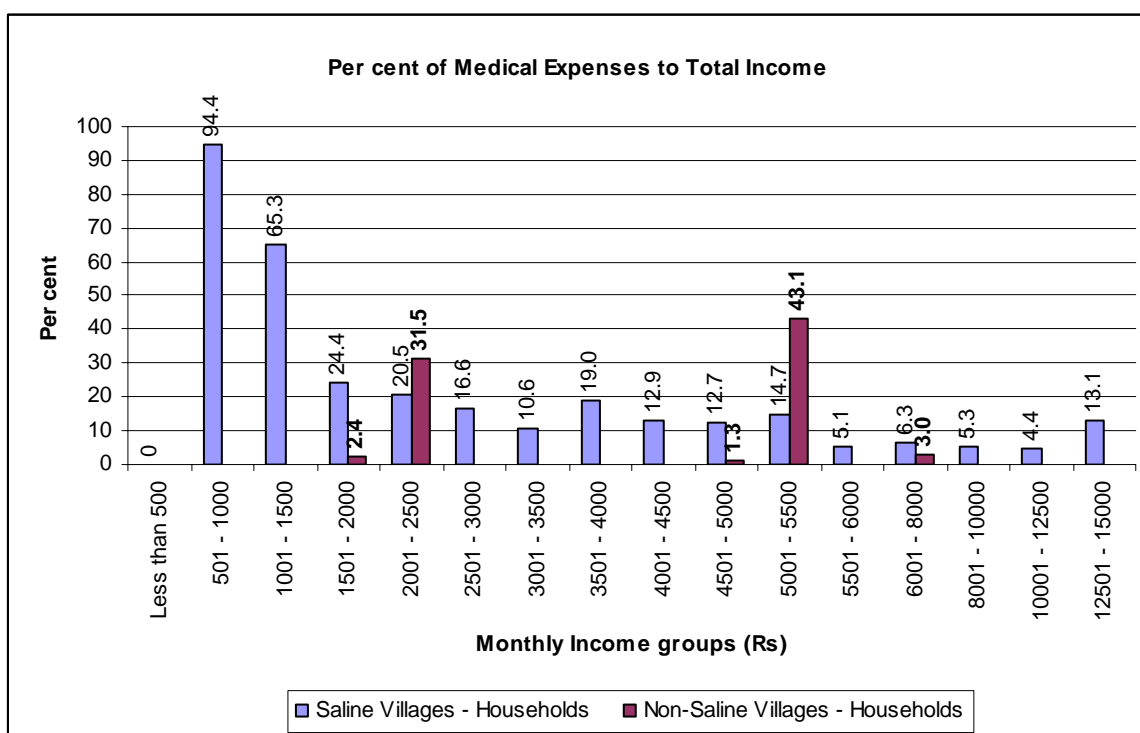
The operation expenses vary from Rs 8000 to Rs 12000 in Junagadh, and it is less at Bhavnagar because the hospital is run by a charitable trust. The operation fees vary according to the size and the place where the stone is located. These expenses are much higher in Ahmedabad than that in Junagadh, but of course the expenses depend on the kind of hospitals/clinic they go for medical

Saline Villages Monthly Income Groups (Rs)	No. of HHs in Monthly Income Group	No. of Patients in Monthly Income Group	Annual Income of Monthly Income Group (Rs)	Medical Expenses of Monthly Income Group (Rs)	% of Med Exp. of Total Annual Income of that monthly Inc Group	% of Med Exp to Total Income of All HHs	% of Group Income to Total Annual Income	No. of Person Reported Wage Loss acc. To Monthly Income Group	Wage loss of these Persons
< 500	-	-	-	-	-	-	-	-	-
501-1000	3	3	27000	25500	94.4	2.5	0.4	3	14250
1001-1500	5	5	75000	49000	65.3	4.8	1.0	3	8800
1501-2000	14	14	294000	71750	24.4	7.0	4.0	6	13550
2001-2500	16	19	432000	88500	20.5	8.7	5.9	5	37500
2501-3000	35	37	1155000	191750	16.6	18.8	15.8	19	65620
3001-3500	19	22	741000	78250	10.6	7.7	10.1	13	43500
3501-4000	12	14	540000	102750	19.0	10.1	7.4	5	11000
4001-4500	12	14	612000	79000	12.9	7.8	8.4	5	13950
4501-5000	8	8	456000	58000	12.7	5.7	6.2	4	7600
5001-5500	8	10	504000	74250	14.7	7.3	6.9	2	10700
5501-6000	6	8	414000	21200	5.1	2.1	5.7	5	32350
6001-8000	8	10	672000	42250	6.3	4.1	9.2	3	12700
8001-10000	4	5	432000	23000	5.3	2.3	5.9	3	3525
10001-12500	1	1	135000	6000	4.4	0.6	1.8	0	0
12501-25000	5	6	825000	108000	13.1	10.6	11.3	3	3100
<b>Total</b>	<b>156</b>	<b>176</b>	<b>7314000</b>	<b>1019200</b>	<b>13.9</b>	<b>100.0</b>	<b>100.0</b>	<b>79</b>	<b>278145</b>
Per Person				<b>5790.9</b>					<b>3520.8</b>
Per HHs			<b>46884.6</b>	<b>6533.3</b>					<b>1783.0</b>
<b>Non-Sal Vill</b>									
1501-2000	2	2	42000	1000	2.4	0.8	9.1	0	0
2001-2500	1	1	27000	8500	31.5	7.0	5.8	1	9000
4501-5000	1	1	57000	750	1.3	0.6	12.3	0	0
5001-5500	2	2	252000	108500	43.1	89.5	54.5	1	4500
6001-8000	1	1	84000	2500	3.0	2.1	18.2	1	3500
<b>Total</b>	<b>7</b>	<b>7</b>	<b>462000</b>	<b>121250</b>	<b>26.2</b>	<b>100.0</b>	<b>100.0</b>	<b>3</b>	<b>17000</b>
Per Person				<b>17321.4</b>					<b>5666.7</b>
Per HHs			<b>66000.0</b>	<b>17321.4</b>					<b>2428.6</b>

care. We have found an average total expense per person is Rs 5790 among the patients of saline villages, which includes accompanied person's expenses of about 3% of the total cost. The average medical expenses are found nearly 14% of their total income among all the population in saline villages; the range was from 4.4% to 94.4%; and in the lowest income group (Rs 501-1000) it has gone up to 94% (Table – 2). Among the households of saline area it is observed that the per cent of medical expenses is higher in lower income groups than in the higher income groups (Chart - 3). It is obvious as they can not take care of their regular health care, so they when fall sick, they have to spend as much as they can for their cure.

The patients of non-saline villages have spent more on their medical bills. It is for their affordability. The average expense per patient in non-saline area is Rs 17321. We found one family had been to Bombay for his operation, and had spent more than Rs one lakh. Since the selected number of households and patients both are only 7 this average figure happened to be high. The people of non-saline villages have spent 2.4% to 43% of their total income for medical expenses from the monthly income groups of (Rs 1500-2000) and (Rs 5001 to 5500) respectively. This may be due to the occurrence of kidney stone is very less, and when occurred they could take the best possible medical package. The urologists say that 80% of the kidney stone cases are repetitive within 5 to 7 years. Therefore the afflicted families particularly from saline area may have to spend again and in the future unless they can change the water quality they drink, which may be the major cause for kidney stone of this district.

**Chart – 3: Percent of Medical Expenses to Total Income in Saline and Non-Saline Villages**



Source: Field Data

#### 6.4 Wage Loss for Kidney Stone Ailments

The average annual income per household in saline area families is less than Rupees 2 lac. All the afflicted people have not lost their wages since many of them were not earning members. Among 176 afflicted persons from saline area only 79 persons reported their loss in wages. Thus per reported person wage loss in saline area was found as Rs 3520 whereas it is Rs 5666 for the reported persons of non-saline area (Table – 2). There were only 3 persons reported for wage loss in non-saline area. As told earlier the general income of non-saline area is quite high and therefore the wage loss happened to be high.

## 7. EXPENSES ON BUYING DRINKING WATER

In general people use the village sources for drinking water, either from Panchayat supplied one or from irrigation wells nearby. The average TDS found more than 3400 mg/litre and Calcium nearly 300 mg/litre mentioned above in Table – 1. In saline villages, people buy water daily for about 150 days in a year at the rate of Rs 5 to Rs 7 per 35 litres of carboy. Its water quality is questionable because the water is brought from wells of nearby villages where water is comparatively less saline. In the report of the 25 samples collected from these sources – 5 each from 5 saline villages, we found that the TDS contained it about 700 mg/litre and Calcium more than 60 mg/litre. The expense on this drinking and cooking water is Rs 5/- (minimum), assuming the lower price of Rs 5/- we get Rs 750 per year per family for 5 months in a year. The people from non-saline area do not spend this amount or may be spending very rare in some drought years. Families, who have RRWH underground tank with a capacity of 10000 litres, are also to buy one or two tank full of water towards the end of the year at the rate of Rs 250 to Rs 300 per tanker of 5000 to 7000 litres of water.

## 8. REPORTS FROM AN UROLOGIST

### 8.1 Dr. Shyam Sonaiya's Report of 25 Patients

As part of methodology of this study, we selected 20 patients for clinical and pathological tests out of 176 patients from saline villages and 5 non-patients from non-saline villages. These 25 people, 18 men and 7 women were sent to a local urologist Dr Shyam Sonaiya, who has his own private clinic at Junagadh city. The doctor has arranged all the necessary blood, urine test and also x-ray and ultra-sonography examination. His certified report is as follows:

**“Total 25 patients were examined in the study. Out of them six (6) patients, who were from saline area villages were suffering from stone. In this study normal person (patients) are having a few urinary symptoms or pain. Those may be due to some other infection, which needs to be investigated. The incidence of stone disease in study region of Saurashtra and Kutch is very high. There are many other reasons also, but one of the important reasons is high TDS level in drinking water.”** Sd/- by Dr Shyam Sonaiya.

From the details of this information we found 19 patients were from saline villages, of them 6 persons were diagnosed of having kidney stones, which means 31.6 per cent occurrence of kidney stone. Rest 13 and 6 of 25 persons from saline and non-saline villages respectively were normal, however a few of them have some other urinary complaints as told in his report, which need further investigations. The size of the stone is varying from 5 mm to 17 mm. The range of age is from 8 years to 38 years. Out of 6 stone cases, 4 were men and 2 women; here also we found that men are more prone to this ailment. See some photographs of kidney stones collected from Dr Sonaiya's clinic at Junagadh city.

### 8.2 Chemical Analysis of Kidney Stone and Lithotripsy

We could not collect records from all the private clinics or from the hospitals, as all of them were not ready to co-operate. Dr Sonaiya has co-operated and even shared two of his past records from his clinic. (1) Chemical analysis of 119 operated kidney stones from in-patients of his hospital during 2006. (2) Records of 115 Lithotripsy operation cases took place during 2006.



We summarised records of (1) and found out of 119 kidney stones 94 (79%) were operated from male patients and 25 (21%) from female; 2 stones from juvenile patients, one each from a boy and a girl. All the stones were composed of calcium-oxalate (Cal-Ox) – 47.9% with degree 2, 41.2% with degree 3, and 10.9% with degree 1. This means Calcium is the main binder with Oxalic acid, and therefore the doctor stated that Calcium is the cause of kidney stone in this area.

In the report (2) of Lithotripsy cases during the last year, there were 115 total cases of which 85 (73.9%) were male and 30 (26%) were female. Here also it is found men suffered nearly three times more than the women; among other reasons female hormones help to inhibit stone formation. This doctor got 10 lithotripsy cases every month in the last year besides other general surgery cases of kidney stone.

This was the report from only one urologist of Junagadh city. A detailed compilation of reports from the Government Department of Urology and other clinics of Junagadh may provide a much more alarming picture.

## 9. TO CONCLUDE

1. Intrusion of saline water from sea has increased the salinity of groundwater. The main source of irrigation being groundwater, the salinity has reduced the productivity of agriculture, particularly the Rabi crops like wheat. Farmers changed their crop pattern mainly towards groundnut, and depended mostly on one crop cultivation. This has reduced their income.
2. Rich people, those had opportunity left village and settled in sweet water area. Those who could not stay in the village with hardship. They depend on farm and non-farm labour in and outside their village.
3. Coconut and '*kesar*' mango farming were damaged very severely due to salinity. The fruits of coconut got shrunk by a-third and could fetch very less now. In Husseinabad village the orchards of '*kesar*' is not much visible now, which were plenty a few years ago, they say. Thus the income of these coconut and mango orchard owners is reduced.
4. Apart from these impacts on agriculture, there is impact on health due to high salinity. Nearly 5% people are afflicted by kidney stone in the saline area villages. In the selected households from the villages of saline area we have per household annual income is Rs 46885, per household (a) medical expense is Rs 6533, (b) wage loss Rs 1783 and (c) water cost Rs 750; hence total of (a), (b) and (c) is Rs 9066 which is about 19% of the per household income, when there is one afflicted person in home. In some individual families the ratio of expenses to income is very high, depending upon the severity of the ailment. There is 80% per cent chance recurrence of kidney stone. If the 'bread-earner' of a family suffers from kidney stone ailment then the family's over all economy become further worse.
5. Though the cause of kidney stone is very complex and wide, in the area of study the major cause is the presence of high amount TDS and calcium in the drinking water.

The environment of extreme climate, sweating, and food habits of people, intake of lime with 'masala', not drinking sufficient quantity of water accelerates the formation stone in kidney.

6. Besides all these there are impacts on social aspects also. There is typical resistance regarding marriages between the families of saline and non-saline villages. This social impact is difficult to quantify. A high tendency of migration was observed among the people of saline villages.

Identifying the cost of high incidence of kidney stones due to high salinity and other impacts on agriculture and society, the problem deserves to get immediate attention from concerned authorities before it gets further worse.

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