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Livelihoods of Agariyas and Biodiversity Conservation in the Little Rann of Kutch, Gujarat

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Foreword

The Centre for Economic and Social Studies (CESS) was established in 1980 to undertake research in the field of economic and social development in India. The Centre recognizes that a comprehensive study of economic and social development issues requires an interdisciplinary approach and tries to involve researchers from various disciplines. The Centre's focus has been on policy relevant research through empirical investigation with sound methodology. Being a Hyderabad based think tank, it has focused on, among other things, several distinctive features of the development process of Andhra Pradesh, though its sphere of research activities has expanded to other states as well as to issues at the nation level.

The Research Unit for Livelihoods and Natural Resources (RULNR) was established in the CESS in the year 2008 with financial support of Jamsetji Tata Trust. The core objectives of the RULNR are to conduct theoretical and applied research on policy relevant issues on human livelihoods and natural resource management, especially in areas related to river basins, forest and dryland ecosystems and to provide an effective platform for debates on policy relevant aspects for academicians, policy makers, civil society organizations and development practitioners. RULNR intends to adopt a multi-disciplinary approach drawing on various disciplines such as ecology, economics, political science, and social anthropology.

The present Monograph by Dr Jyothis Sathyapalan et al is an attempt to understand the interface between livelihoods and wildlife conservation in the little Rann of Kutch. The concept, 'livelihood', has been extensively discussed in academic and development practitioners circles. The basic characteristic of the discourse on livelihood is the consensus that it is about the ways and means of 'making a living'. The money earned out of traditional salt production or wage labour is the main source of income that supports Agariyas livelihoods. This study shows that the life in the desert is in a low level equilibrium that is characterised by low income, high poverty, occupational illness, and fewer opportunities for education. Incidences of high poverty and malnutrition;and lack of basic amenities are also attributed to this low level of living. However, the study finds immense scope for improving the livelihoods of Agariyas without compromising on the biodiversity conservation concerns. From the analysis, it is clear that livelihood augmentation of Agariyas in terms of improved incomes is possible by improving the quality of salt through brine management and developing market strategies. The livelihood security can be ensured through institution building to correct market imperfections and by reducing risks involved production of salt. In this context, livelihood augmentation simply means lifting them from the low level equilibrium position, through various actions at the farm level, while focusing on technology and awareness about scientific methods of production. The study recommends short term and long term measures to bring about an improvement in the livelihoods through ensuring livelihood security and striking a balance between livelihoods and conservation.

The study could not find any significant external cost of salt production on wildlife. Besides, the present system is found to be more traditional and wildlife conservation-friendly. The elicitation of environmental preferences of Agariays also shows that they are not against the conservation of wild-ass; but some of them are worried about their livelihood due to the fear of a possible eviction from the LRK. Governing the livelihoods of salt pan workers is the most important challenge in the context of wild ass conservation. The policy need to address all such issues so that there is a balance between conservation and livelihoods of Agariyas. It is also important to recognise Agariyas as a forest dwelling community under the Indian Forest Right Act 2006. The risk of a possible eviction from the LRK has been disturbing the Agariyas which may hinder the conservation initiatives. The non-settlement of the land rights even after 40 years of the declaration of the sanctuary has remained a major concern which needs to be resolved on a priority basis. The eviction of salt pan workers from the LRK does not seem to be a practicable solution. Interactions between Agariyas and the State can lead to a more meaningful governance system in the LRK. The issue should be addressed by taking both the livelihoods and conservation concerns into consideration.

This monograph thus contributes to our understanding of various dimensions of livelihoods and wildlife conservation in general and ways to augment livelihoods security of Agariyas in the Little Rann of Kutch without compromising the conservation needs in particular. I hope that the research community, policy makers and development practitioners shall find it useful.

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Chapter-I
Introduction

1.1. The Background

India happens to be the third largest salt producing country in the world after China and USA. The major sources of salt in India include Marine, Subsoil, and Lake brines[1]. A small quantity of rock salt is also produced in India. This apart, efforts are also being made of late to produce salt from plant materials through innovative techniques. The country is endowed with a diversified source of brine for salt production. It provides income, employment and livelihoods for millions of people living in the coastal areas. The predominant types of salt produced in India are sodium, magnesium and calcium in combination with sulphate, chloride and carbonate. Sodium chloride (common salt) is produced in large areas managed by industries as also in small salt pans maintained by individuals. Apart from common salt, other chemicals like Calcium Sulphate ($CaSO_4$, $2H_2O$), Magnesium Sulphate ($MgSO_4,7H_2O$), Magnesium Chloride ($MgCl_2,6H_2O$), Potassium Chloride (KCl), Potassium Sulphate (K_2SO_4), Bromine (Br_2) are also produced in India from sea and subsoil brines. Sodium Sulphate (Na_2SO_4) is also produced from lake brine in Rajasthan. The annual salt production of the country has crossed over 221.79 lakh tonnes in 2011-12. It is produced in 52 districts of 8 states in the country. Gujarat, Tamil Nadu and Rajasthan being the top producers of salt. It was reported that about 13000 salt manufacturers produce salt across about 5.50 lakh acres of land with 90 per cent of the manufacturers are marginal producers having less than 10 acres of area providing employment on a large scale in India (GoI, 2012). As per an estimate, more than 100,000 people were employed per day in salt industry for the year 2000 (GoI, 2012). The private sector, including marginal salt manufactures, continues to contribute about 90.30 per cent of the total production of the country, while 8.35 per cent by co-operatives and the remaining by joint and public sector undertakings (GoI, 2012). The

[1] Brine is a solution of salt (usually sodium chloride) in water. In different contexts, brine may refer to salt solutions ranging from about 3.5% (a typical concentration of seawater, or the lower end of solutions used for brining foods) to about 26% (a typical saturated solution, depending on temperatures).

role of marginal farmers in the overall contribution is quite significant. Salt produced in India is used for industrial purposes, domestic consumption and exports. Approximately 51 per cent of the total production goes to industry as an intermediary good, particularly Caustic Soda and Soda Ash industrial units, which account for 39 per cent of the total industrial use. The export of salt comes around 17 per cent while the remaining 32 per cent is sold in the domestic market for human and animal consumption and also for other end uses such as preservatives, agriculture, etc. Salt plays a vital role in the Indian economy as an intermediary commodity for industrial production and domestic consumption. Nevertheless, a majority of the marginal salt producers continue to remain poor due to various reasons. They are mostly marginalized or ignored and under represented in national and international policy forums. Unlike their large-scale counterparts (industrial producers), marginal salt producers face various challenges in the production cycle, perhaps because they employ traditional methods, operate seasonally, often combining salt production with other livelihood practices. It is also common for family members, including women and children to be involved in salt production. Considering that salt production is a major livelihood activity of marginal producers who face various production related challenges, their contribution to the overall economy cannot be solely measured in terms of revenue generation and economic development. In fact, their, important role in food security, poverty alleviation, social well-being and tradition needs to be fully accounted for, and incorporated into public discourses concerning salt policy and governance. This study is focused on the livelihoods of marginal salt produces in the Little Rann of Kutch (LRK) in Gujarat.

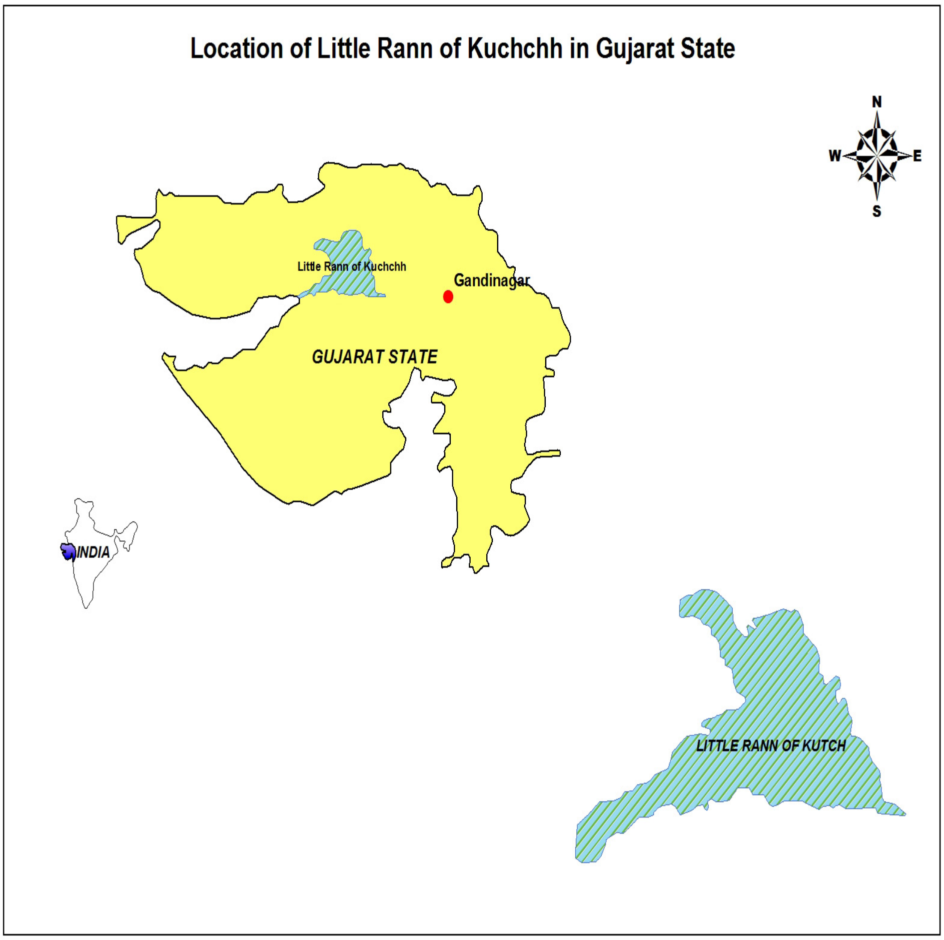
1.2. The Little Rann of Kutch

This section explains the ecological characteristics of the LRK and their significance to local livelihoods. The LRK is located between 22° 55' N to 24° 35' N latitudes and 70 30' to 71 45'E longitudes. The area receives an average annual rainfall of about 300 mm (Sheshadri, 1986) (Singh and Patel, 1997). A brief and erratic monsoon, hot summer and cold winter characterize the general climate of the area. The maximum temperature averages about 42°C, while minimum temperature averages about 12°C with a relative humidity of about 25 per cent (Hussain and Roy, 1993). However, maximum temperatures could be as high as 50°C while minimum temperatures dip to as low as 1°C. The area accounts for the highest annual evaporation rate in the country. Geologically, the area belongs to one of the most complex regions in India. As per the Gazetteers of India (1965, 1973), the LRK is the southern continuation of the Greater Rann of Kutch of Gujarat. It is characterised by vast desiccated bare mud-flats consisting of dark silt encrusted with salts. These mud-flats are not soft or slimy except in a few isolated patches.

LRK has 74 elevated plateaus or islands called *'bets'* of which *Pung bet*, with an area of about 30.5 sq.km, is the largest and *Mardak*, the highest with an elevation of 55 m above the mean sea level. The lower parts of LRK surface are characterised by encrusted salts forming salt playas during rains; the deeper portions are made up of clay with traces of mica (Babbar, et al., 1994).

The LRK is a seasonally flooded wetland ecosystem. The rivers like Banas, Saraswati and Rupen, besides innumerable seasonal streams and surface water runoffs are the main sources of freshwaters. Banas, originating in Rajasthan, flows for about 40 km in Mehsana district before disappearing into the LRK near Pedaspura village of Radhanpur. Saraswati, originating in the hills of Menagar in Aravalli, courses for about 114 km in Mehsana district before ending in the LRK near Tarangar village of Sami taluka. Rupen arises from Taranga hills in Mehsana district, and meets the LRK near Tarangar village of Sami taluka after flowing for about 135 km. All these rivers have numerous main and sub tributaries. Some freshwater also from a nearby part of the Greater Rann flows into it through the channel connecting the LRK with the Greater Rann. Whenever the LRK gets flooded with rain water, the coarser fluvial sands and silts get deposited at the mouths of in flowing rivers, while the fine sediments are carried further into the Rann before merging with the marine sediments of inter-tidal flats. The inundation of this wetland occurs both through tidal waters from south-west and rain fed fresh waters brought by the various inland rivers. The contribution of freshwater is more than that of tidal waters. The Gulf of Kutch constitute the main source of tidal waters even when freshwaters in the LRK dry up as tidal waters still pour into the LRK through the Gulf. According to Patel (1971) when strong westerly winds set-in in March, the Gulf of Kutch water is heaped up, rising slowly over the LRK, until rains cause inundation, ranging from a few inch to a few feet indepth. The Gulf-LRK linkage can be seen at Surajbari Creek. The wetlands in different sites assume varying characteristics, especially in the post-monsoon period. The water body in the LRK near Bajana formed through accumulation of rain water lasts till February or even later.

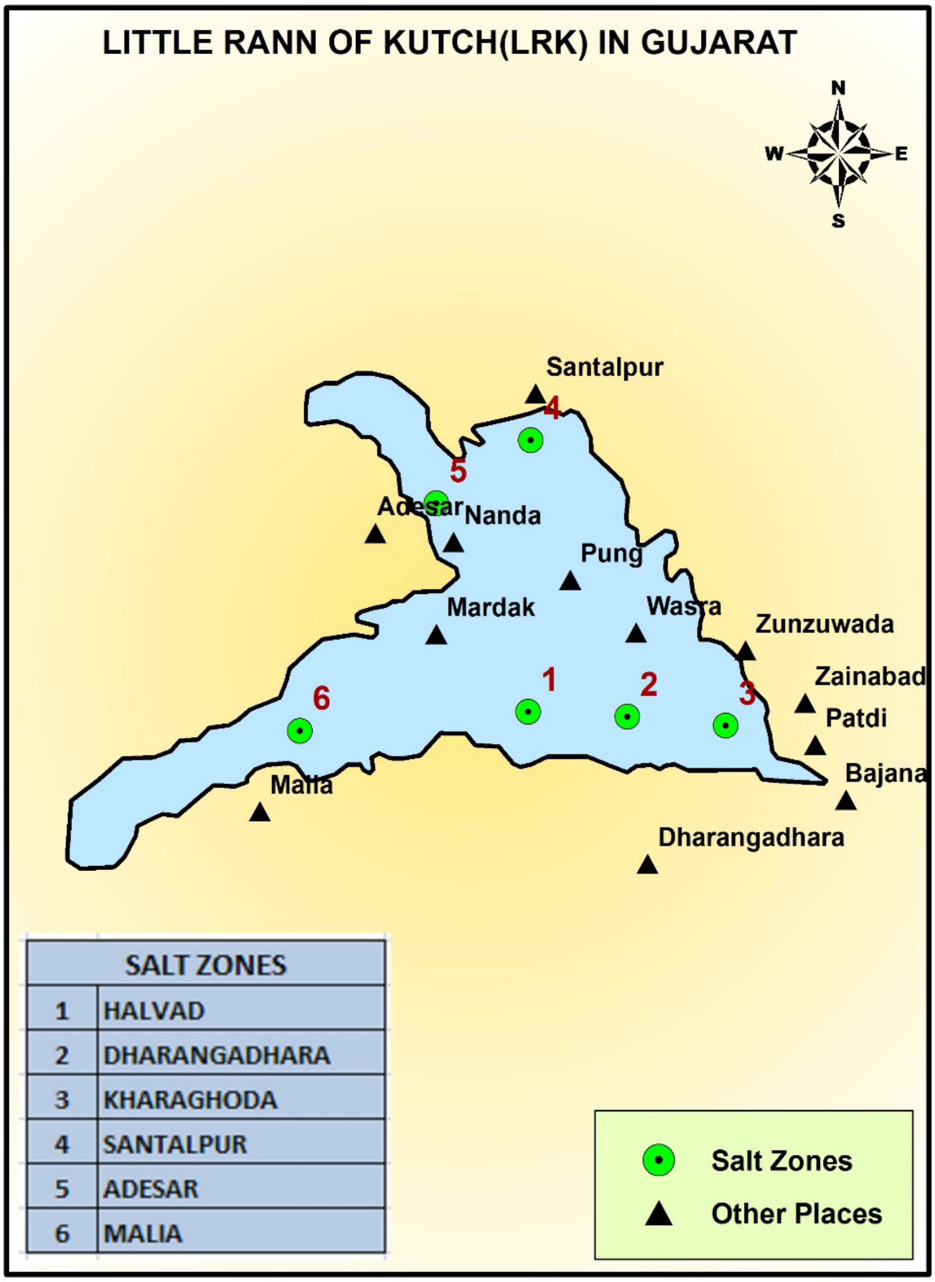
Map 11 Location of the Little Rann of Kutch



Note: Map not to scale

The part of the LRK near Nanda and Shedwa Bets is formed by both freshwater and tidal waters. The portion of LRK near Cherwari village is purely tidal/ saline in character.

Map 1.2. Little Rann of Kutch in Gujarat



Note: Map not to scale

There are four important types of vegetation in LRK namely, Rann Saline Forest, Salvadora scrub, Saline/alkaline scrub and Cassia auriculata scrub (Champion & Seth, 1968). They are further classified into grasslands, scrublands and marshlands vegetation types (Singh and Patel, 1997) as given in Table 1.1 land use analysis presented in this study for a period over 1982-84 to 1995 does not indicate much changes during a 13 year period. However, there has been an increase in the percentage of mud flats and a slight reduction in salt affected areas.

The LRK could be considered a large ecotone transition between marine and terrestrial ecosystems. The vegetation composition on the fringe and Bets depends on the elevation of the area from the mud flat. The ecological succession stages are also as per elevation. Singh et al. (1999), report 253 species of plants. Of these, trees form 18 species, shrubs 23 and herbs 157 species. Thirty seven species of grass and 18 climbers/twiners are also reported. The Report also gives the frequency, density/m^2 and abundance.

Table 1.1 : Classification of Vegetation in the LRK

Vegetation types
Prosopisjuliflora forest
Salvadorapersica - Suaeda scrub
Salvadorapersica - Tamarix scrub
Cassia auriculata scrub
Suaeda type
Capparis scrub
Grassland
Saline grasslands
Saline herbaceous vegetation
Marsh vegetation [Cressacretica, Aeluropuslagopoides , Suaeda and Mixed herbaceous cover]

Source: (*Singh et al, 1999*)

Ten plant species, mostly associates of mangroves, are considered either endangered or vulnerable. A number of species characteristic to the region are declining in terms of population. The study also records 107 species of phytoplankton. A variety of diatoms and blue green algae, which are important for lesser flamingo, greater flamingo and ducks of LRK. The study also has brought out a list of invertebrates. The invertebrates, which are little known and documented in the study, include zooplanktons (25 species), Protozoans (19), Rotifers (1), Nematodes (2), Crustaceans (7), Annelid (1), Molluscans (12), Insects (24) and Spiders (27). The Reptiles reported from the area include 2 species of turtles, 14 lizards, 12 snakes and one crocodile (Singh, *et al.*, 1999) .

The western and southern parts of the Rann support good aquatic resources during the monsoon, when the area is under water (Singh, *et al.*, 1999). The seasonal brackish shallow water lake is a good habitat for fishes and prawns. These shallow water and Hadakiya creek at Surajbari is a traditional prawn picking ground. About 8100 fishermen are actively involved in prawn picking and fishing. Of these, only 4800 are locals belonging to Muslim (Waghers) and Hindu (Kholis) communities. Many crats are used for fishing indicating a high dependence of the community and also the disturbance to the system. Twenty two species of fish have been reported. The most prominent ones are Coiliadussumieri (Golden anchovy), Mugilcephalus (Grey mullet), M. Tade, M. Parsia, Hilsailisha (Indian shad), Harpodonnehereus (Bombay duck) and Pellona elongate. Although eleven species of prawns are reported from the area, a major portion of the catch is of Metapaenaeuskuchensis and M. Affinis. The total catch in the Little Rann in 1998-99 was reported to be about 4100 metric tonnes. As far as birds are concerned, Scott (1989) reports a large concentration of migratory shore birds and ducks in Banas river mouth. A total of 178 species have been reported from the area. These include 81 terrestrial (57 resident, 9 migratory, 15 resident with a migratory population) and 97 water birds (24 resident, 42 migratory, 31 resident with a migratory population). Moreover, thirty three species/subspecies of mammals have also been reported from the area (Singh, et al., 1999). These include five species of ungulates, 14 species of carnivores, one lagomorphs, 6 rodents, 2 bats and one primate.

The LRK is known for an endemic but endangered species of Wild Ass. The population trend of wild ass based on wild life census indicates a drastic reduction in the population from 1946 to 1963 and then an increase to about 4000 in 2009. Bets are reported to be crucial breeding grounds for the wild ass population. The wild ass is distributed within the sanctuary and in the Greater Rann, parts of Rajasthan deserts, Surendra Nagar and Nalsarovar areas outside the LRK. The population estimation indicates a female biased sex ratio. About 40% of the sightings have been reported in the deserts of LRK during day time and a low density scrub lands are identified as the most preferred habitats. The Western and Southern creeks have only very few sightings reported. The animal is frequently sighted throughout the year in the crop lands and fallow lands with the village ponds and irrigated fields being the major water sources in summer. Reports indicate that pods of Prosopisare a major diet component in summer.

Nilgai is the second in terms of number with about 303 sightings reported followed by 130 to 150 chinkaras. The number of chinkara could be much more if the fringe village population is also taken into consideration. Bets are crucial habitat for chinkara. There have been only a very few sightings (19) reported of black buck. Wild boar seems to be the most widely distributed mammal in the sanctuary. About 80-100 wolves, the largest carnivore of the LRK. According to the Forest Department, there are 327 jackals, 180 common foxes, 41 jungle cats and 41 hyenas recorded from the area. The other mammals sighted include desert cat, desert fox, caracal, pale hedgehog, large eared hedgehog, small Indian civet, ratel, smooth Indian otter, common mongoose, Indian mongoose, pangolin, Indian hare, musk shrew, porcupine, five striped palm squirrel, three striped palm squirrel, Indian desert gerbille and common langur. In general, studies show that LRK ecosystem has a high biodiversity value.

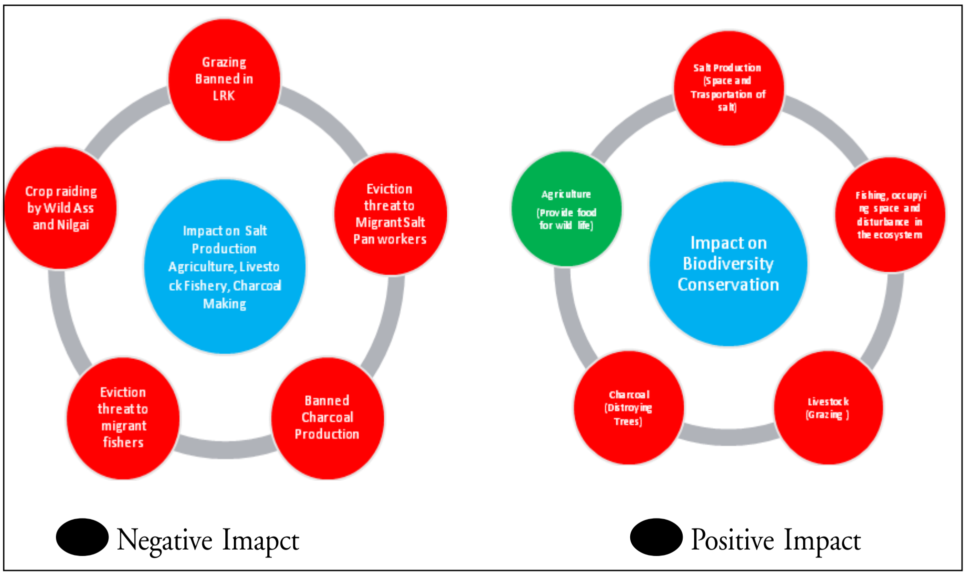
From a biodiversity conservation point of view the most important intervention in the area was the establishment of a wild life sanctuary. An area of 4840.9 km^2 of LRK was notified as Wild Ass Sanctuary (WAS) by the Government of Gujarat in January, 1973. In 1978, an area of 112.8 km^2 was added, thereby expanding the total area to 4953.7 km^2. The most important human intervention in the ecosystem relates to the planting of Prosopis Juliflora for improving the vegetation cover in the LRK. The planting of prosopis was done from 1973 to 1998 over a total area of about 269.70 km^2. Ever since there have been arguments in favour of and against the impact of Prosopis Juliflora on the ecosystem. The arguments supporting Prosopis is that the plant pods provide food for wildlife, act as shelter belts besides facilitating soil stabilization in addition to fuel wood and charcoal for the public. But the other arguments indicate that the exotic species suppress indigenous plant species and that the sparse ground cover has been changed an impenetrable cover, resulting in a loss of herbaceous growth in planted areas. Moreover, the planting of exotic species also has adversely influenced the natural succession in the region.

Development induced changes are also observed in the ecosystem. It is reported that the freshwater flow to the Rann is getting reduced since the last few years due to the construction of dams in the upper catchment areas of rivers (e.g. Banana at Dantiwada). The channels for water flow to the LRK during heavy rainfall remain cut off by the rail and road embankments that connect Pipariala in Banaskantha to Adesar in the Kutch mainland, thus affecting the flow of freshwater from the Great Rann. Other than an ancient well in Mardak bet, the ground water in the LRK is highly saline and totally unsuitable for drinking or any household purpose (Merh and Malik, 1996). Today, water from this well is being utilized by the Forest department for providing drinking water to the wildlife. Studies, with the help of satellite imageries, have identified the configuration of a wide buried channel along the central axis of the LRK, continuing from the mainland in the North East to the head of the Gulf of Kutch in the South wet (Merh and Malik, 1996). This has been cited as another reason for a reduction in the freshwater flow into the LRK. In short, LRK is a rich biodiversity area facing threats from development induced human interventors and livelihood activities.

1.3. Dependency on the LRK for Salt Production

As far as livelihoods are concerned, local people are dependent on the system for salt pan works, fuel wood collection, charcoal making, grazing and fishing. It is an important issue from a biodiversity conservation perspective. A trade-off analysis of various types of livelihoods and conservation (figure 1.1) has been provided in Sathyapalan *et al* (2013).

Figure 1.1 : Interface between livelihoods and Biodiversity Conservation in the LRK



Source: (Sathyapalan, Srinivasan, & Easa, 2013)

Salt production is concentrated in six centres of LRK. Although there are many inland salt production centres in Gujarat, the LRK is considered the main production centre because of its significance in terms of a highly concentrated subsoil brine. The provision of subsoil brine is a service of the LRK ecosystem where the rivers Banas,Sarswati and Rupen and their tributaries playing a very significant role. The flood water of these rivers during monsoon percolates into the underground of LRK that helps dissolve salts that turn into concentrated subsoil brine. It is also shown that the brine in the Rann originate from the sea water connection in the lower Strata of the Rann (Narie, 1964). The subsoil brine formed through an ecological process is five times more concentrated than sea brine. The brine density of normal sea water is only 2.5 to 3.5°Be', while the brine density found in the LRK varies from 6 to 17^0 Be'across different locations. Infact, it is found to be 13 to 17^0 Be' in the southern parts, while it is 6 to 10^0 Be' in the northern locations. The highly concentrated brine of this ecosystem ia a valuable resource at the local level for the salt production that helps approximately 12 to 15 thousand families in sustaining their livelihoods. Nevertheless, it is argued that salt pan works generate externalities for biodiversity conservation in the LRK expanding salt production. Thus, an important governance challenge is to strike a balance between salt production and conservation. This is an important issue that we have addressed in this study, while discussing the possibilities of livelihood augmentation.

1.4. Salt Production Issues in LRK

The Gujarat state produced 170 lakh tonnes of salt during 2011-12 (GoI, 2012) that works out to around 77 percent of the total production of salt in the country of which 14 per cent is accounted for by subsoil brine(GoI, 2012). The main production centres of Gujarat are spread across 14 districts. There are about 1643 unorganized and about 111 co-operative salt units in Gujarat, of which more than 90 per cent are marginal units with an area of less than 10 acres (CSMCRI, 2010).The marginal salt producers face various challenges during the production cycle of salt. Our observations reveal that the marginal salt producers received only Rs 140 to 200 per tonne in 2011,while the market price of standard edible salt ranged fromRs 600 to 800 per tonne and Rs 1250 per tonne for industrial grade salt in Dhrangadhra area of LRK. The salt pan workers receive a very low price due to various reasons and quality is one of the major reasons.The quality of salt is a major concern when it comes to both domestic and industrial use. It is mandatory to supply quality salt in the domestic market as there is a direct relation between the quality of salt and human health. Individual industrial units are also concerned with quality, because impurities in salt can adversely affect their plants and final products. The Bureau of Indian Standards (BIS) provides required quality standards for industrial and edible salts in India[2] .

Even though Nevertheless, meeting the prescribed standards is a big challenge for marginal salt pan workers, particularly those who depend on subsoil brine for salt production in view its inherent quality and method of production. They usually produce salt with high levels of impurities that fetch a low price which, in turn, affects their incomes and livelihoods. An important reason for low quality salt (applicable to Vadagaru) in the LRK is attributed to the traditional method of brine management in the salt production cycle (CSMCRI,2010). Apart from the quality aspect, market imperfections and risks involved in production play a significant role in keeping prices at lower levels.Middlemen and traders play a crucial role in salt production process by way of advancing interest

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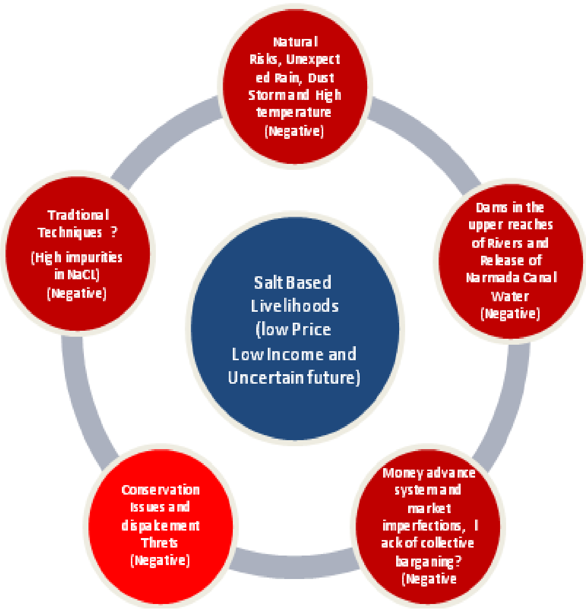
[2] Salt is a central subject in the constitution of India and appears as item No 58 of the union list of the seventh schedule of the constitution. Therefore, the central government is responsible for controlling the salt industry. The salt commissioner's office under the Ministry of Commerce and industry is entrusted with the responsibilities of regulation and controls of salt manufacture and its distribution (GoI, 2012).

free loans in the beginning of the season,while fixing a very low price which prevents salt pan workers from selling their product at competitive prices at the end of the season. Besides, middlemen and traders also tends to take advantage of various risks such as unforeseen rains, high temperatures and dust storms when it comes to offering throw away prices to the salt pan workers. It is reported that an unexpected release of water from Narmada canal, sometimes, destroys salt pans and the entire crop of the season. Further frequent threats from revenue and wild life departments also create uncertainties which traders and middlemen always try to utilise to their own advantage. As a result, most of the marginal salt producers are living in a state of chronic poverty. Factors like low quality salt, market imperfections and other production and market-related risks adversely affect their livelihoods, driving them in to a low level poverty equilibrium trap in the process (Figure 1.2). This vicious circle cannot be broken without an improvement in the production methods and institutional measures and also for addressing market imperfections and various other risks. Thus, the study focuses on some of the above said issues in the context of the livelihoods of salt pan workers in the Little Rann of Kutch, Gujarat, besides suggesting feasible ways to augment secured livelihoods for salt pan workers. Thus,the most important questionis how to augment livelihoods of salt pan workers without compromising on the conservation objective of the LRK. The following section presents different perspectives on conservation and salt based livelihoods issues of the LRK. (Appendix Table 1-A)

Figure 1.2 : Factors adversely affecting the livelihoods of salt pan workers



1.5. Perspectives on Wild Ass Conservation

An important research document that looks into both the ecosystem characteristics and livelihood dependency is the report prepared by the Gujarat Ecological Education and Research Foundation(Singh, Patel and Pravez, et al, 1999). The report brings to the role of LRK ecosystem in supporting the livelihoods of local communities, especially Agariyas. The study notes that since salt production activities are confined to the salt zones of LRK, it is not in conflict with biodiversity, particularly Wild Ass conservation. However, the study observes that an expansion of salt zones may adversely affect the conservation objectives of Wild Ass. It recommends the demarcation of salt zones and fixing of the boundary of the sanctuary as a solution to reduce anthropogenic pressures on the conservation zone.

A study by Centre for Environment and social Concerns also highlights the importance of demarcating the salt zones in the LRK in terms of strengthening the livelihoods of Agariyas, because conservation of Wild Ass restricts their access to LRK for salt production. The study indicates at a high opportunity cost of conservation in terms of forgone access to the ecosystem for livelihood uses. As a solution, it recommends the de-notification of salt zones (about 58892 hectares). A status paper prepared with respect to biodiversity conservation and livelihoods programme of the LRK (CESC, 2006)argues that anthropogenic pressures, in the make of salt production and storage, might adversely affect the wild life. Therefore, the study suggests a further research for a deeper understanding of the livelihood and wild life habitat issues. Habitat shrinkage and disturbance due to transport are the two major externalities identified in this study (CESC, 2006).

A study by Bharwada and Mahajan (2008) reports that salt areas are not in conflict with wild life's food and water needs as salt pans are made in the areas where nothing grows, but an uncontrolled growth of Prosopis Julifora on the small hilly areas (bets) in the LRK has severely damaged the prime habitats of wild ass. Today, wild assess are adapting to a new environment outside and beyond the LRK (Bharwada and Mahajan, 2008).

In short, all these studies point to two prominent views: (a) salt production has a negative impact on Wild Ass habitats in view of the expanding areas of salt production and transporting of salt by trucks; (b) the salt zones are not in conflict with respect to wild life's food and water needs as salt pans are made in the areas where nothing grows. The loss of habitats is attributed to an uncontrolled growth of Prosopis Julifora on the bets of LRK. It is also observed that many of the wild assess are adapting to a new environment outside and beyond LRK wildlife sanctuary since their population has grown at very high rate.

It is also clear from the studies that the issue of conservation vis-a-visl ivelihood still persists, because the non-settlement of land rights remains a long term challenge to sustainable livelihoods. We have argued that the interactions between conservation and livelihoods support each other, depending upon the type and the level at which human interventions take place. In this context, it is important to distinguish commercially-oriented intensive production methods from subsistence level livelihood sources.

We have discussed this issue in detail in a separate report on the biodiversity conservation in the LRK (Sathyapalan, Srinivasan, & Easa, 2013) that shows the cost of conservation borne by the local communities in terms of crop and other livelihood loss due to wild life and a restricted access to the LRK is significantly high. The co-operation of local communities is found to be essential for conservation of wild ass since this animal survives on food and water from nearby agricultural lands. The study also points out that frequent notices from the forest department towards the eviction of Agariyas from the salt zones have adversely affected their perceptions with regard to conservation. The risk of eviction from the LRK continues to remain an important challenge in terms of providing secure livelihoods to Agariyas. The report by Sathyapalan *et al* (2013) also notes that a centralised protected area approach to the LRK is a failure and that it creates a conflict between the local people and the park management. A Participatory and interactive governance with the active involvement of all the stake holders is important for striking a balance between local livelihoods and conservation in the long run. Therefore, while addressing the livelihood challenges of salt pan workers, an important challenge before the study is to find effective solutions that help achieve a balance between salt-based livelihoods and biodiversity conservation.

1.6. Perspectives on Salt Based Livelihoods

Another set of studies deals with the possibilities of augumenting livelihoods by producing quality salt in the LRK. The Central Salt and Marine Chemicals Research institute conducted various experiments in the LRK with a view to improve the quality of salt; a few of them are presented in Table 1.2. Although some of these experiments are found to be both capital and input-intensive, they show an immense scope for improving the livelihoods through improving the quality of salt and extracting of various by-products from the brine. These studies indicate that the selection of technologies that are less capital-intensive and conservation-friendly can be a real challenge towards augmenting Agariyas' livelihoods.

Table 1.2 Summary of experiments conducted in the LRK for improving the quality of salt

Research Experiments	Reporting
Sapre and Bhatt, 1964	This experiment used salts from two locations in the LRK (Sumadi&Kharaghoda). The wash liquor used was either water or a saturated salt solution. The experiment noted the maximum removal in Sumadias Magnesium Chloride 85%, Magnesium sulphate 89%, Calicium sulphate 38% and water in soluble -77% while Magnesium Chloride 13%, Magnesium

	sulphate 100%, Calcium sulphate 6% and water in soluble 66% loss of salt with fresh water wash-21% and that with saturated brine-6% in Kharaghoda area. Washing salt at the farm level might not be a feasible solution for Agariyas.
(Sapre,Bhatt and Bhatt, 1964)	This experiment tried to find out a pattern for deposition of $CaSo_4$ from brines, such as sea water, lime treated sea water and a subsoil brine of Kharaghoda as well as for predicting the proportion of calcium sulphate that may be expected to be co-precipitated with common salt besides the effect of NaCL addition and also other ions such as excess Sulphate ions ; and the results a reduction Calcium sulphate corrosion in brine. Importance was given to mechanisation and adding chemicals from outside.
(Pesikka, 1964)	The study dealt with inland salt manufacture in the Little Rann of Kutch and the scope for its development. It examined the chocking of suction by mud and sand, percolation, mechanical harvesting of salt, mechanization of heaping, leading, bagging etc. Importance was given to mechanisation.
(Swaminathan, 1964)	This paper dealt with the development of salt industries, mechanization in boiling of brine, transportation of brine, harvesting and loading of salt in Kharaghoda. The paper also focused on cost of production. Importance was given to mechanisation.
(Narie, 1964)	The study explored thegeology of underground brine in the Little of Kutch. It is shown that the brine in the Rann originated from the connection through sea water in the lower Strata of the Rann
(Mehta and Bhatt, 1965)	A Study on the set -up of salt works and the possibilities of a recovery of by-products from bitterns and the possibilities of KCl, $K2SO_4$& $MgCl_2$Recovery from low and high sulphate containing bittern was carried ou tin Kuda region.
(Ghaudhari and Mehta, 1965)	A survey on availability of bitterns-sulphate free and sulphate containing and kainite respectively was carried outland a process developed at CSMCRI. Crystalline Mg Cl_2 was also prepared from bittern. It is conducted in Kharaghoda.

(Mehta,Udvadia and Kawa, 1965)	Investigated into the production of potassium sulphate from mixed salt obtained from salt works of the LRK,highlighting the process technique (floatation) and cost estimation. The method was uneconomical, and the processing cost was toohigh.
(Jain,)	Contains a detailed discussion on the problems of LRK - Kharaghoda: (1) tapping subsoil brine economically; (2) selection of suitable sites for laying salt works; (3) modification of process of salt manufacture and (4) recovery of by-products from bitterns and their possible resolutions.
(Mehta,Desai and Gadre,1967)	A composition of brine and bittern from all the major salt works of Kharaghoda region is given along with estimates of recoverable quantities of kainite and carnallite types of mixed saltin respect of Kharaghoda.
(Raval & Satyanarayan)	About 80 bittern samples from the inland salt works of LRK (Kuda) were studied to evaluate the removal / recovery of substantial amounts of bromine. It was found to 32 - 37 oBe' range density the optimum on for bromine recovery.
SRI, Vol. 11, No. 1, P. 49 , March 1975 Notes & News	In northern Kutch at Kuran village 20 km from Khavda, experimental farm taking place for recovery of potassium chloride from subsoil brine. CSMCRI has established this recovered at category scale. It is assumed that the area has such a high potential that it can meet the requirement of the whole nation. The State government has taken a policy decision to exploit the area. A four year programme is envisaged for preparing a techno-economic report.

Source: Various Experiments of CSMCRI

Shukla (2012) examines the value chain of salt production in the LRK. The study finds that the primary producer gets 3 paisa per kilogram of salt, whereas, the trader gets 27 paisa per kilogram of salt and that when it reaches the final consumer, the price per kilogram will be Rs.14. High market imperfections are also observed.The value chain estimates as presented in Shukla (2012) is provided in Table 1.3

The review also shows the interconnected nature of factors related to product quality, market imperfections and risks in keeping livelihoods at a lower level. The price factor is connected to quality, market imperfections and risks. Therefore, the study takes all these factors into account while analysing the livelihoods of Agariyas. As already mentioned above, the prime concern of this study is how to augment and also how to secure the livelihoods of salt pan workers without compromising on the biodiversity conservation objective?

Table 1.3 Value Chain of one kilo of Edible Salt (in Rs.)

No.	Subject	Price
1	Average Cost of Primary Producer (without labour cost)	0.14
2	Selling Price of Primary Producer	0.17
3	Average Cost of Private Trader	0.61
4	Selling Price of Private Trader	0.88
5	Selling Price of Commission Agent	0.89
6*	Average Variable Cost of Company	6.59
6.1	Price of Company	6.60
6.2	Average Cost of Sales Department	7.35
6.3	Selling Price of Sales Department	9.80
7	Average Cost of Main Dealer	10.05
8	Selling Price of Main Dealer	10.95
9	Average Cost of Medium Dealer	11.10
10	Selling Price of Medium Dealer	12.00
11	Average Cost of Small Dealer	12.20
12	Selling Price of Small Dealer	13.10
13	Average Cost of Retailer	13.20
14	Selling Price of Retailer	14.00
16	Price paid by Final Consumer	14.00

Source: Shukla 2012

1.7. Objectives

The basic objective of the study is to examine the techno-economic viability of salt production and also to find ways to improve their livelihoods without compromising on the conservation needs of the LRK ecosystem. The specific aspects covered in the report are as follows:

- To examine the socio economic characteristics and the state of poverty of Agariyas
- To analyse the techno-economic viability of salt production in the LRK
- To develop strategies for augmenting the livelihoods of Agariyas

The findings of this report are mostly based on the primary data collected through a survey conducted among the Agariyas in the little Rann of Kutch during 2011-12 seasons. In addition,, data related to the laboratory experiments of salts and brine from LRK is also used.

1.8. Methodology and Data

The review of literature shows that the Agariyas are trapped in a low level of poverty equilibrium due to various factors among which, quality of salt, market imperfections and risks are significant. As far as livelihood augmentation possibilities are concerned, improving of salt quality is the prime concern. Thus it is important to find out whether Agariyas are interested in improving the quality of salt. Logically speaking there are no economic incentives for them to improve the quality of salt because of issues like brine scarcity and market imperfections. Here, subsoil brine is the basic resource, which is found abundant only in winter and becomes scarce in summer. As a result, Agariyas adopt different strategies to maximise their salt production before the season ends. Their main goal is to produce a large quantity of salt rather than producing better quality salt before the season ends. Therefore, it is very natural that they adopt techniques that fetch them a maximum yield at the shortest possible period. Secondly, there is no market incentive to produce better quality salt due to high imperfections prevailing in the markets as they do not guarantee competitive prices for better quality salt. Thus it is important to adopt a strategy that is feasible to implement within a short time period. Therefore we tried to identify issues that could be solved within a short period of time so as to improve the quality of common salt and to promote the extraction of by-products (non-common salts) at the farm level. With proper institutional arrangements for marketing as also avoiding production risks, the livelihood scan be made more secure without affecting the biodiversity conservation.

Data for this study was collected through key informant Interviews, focus group discussions as part of a primary survey. A sample of 210 Agariyas was covered through a survey using a semi- structured interview schedule. In the absence of reliable information for designing a sample frame for selecting households, we adopted, what we have labelled as, a 'random walk method'. The sample households were drawn from four important salt zones in the LRK namely, South East zone, North East zone, North West Zone and South West zone. Two important components of sampling were the size of salt zone and brine density. The south east zone includes salt producing locations of Kharaghoda, Kuda, Zinzuwada and Halvad. The South east zone is the largest zone in terms of area and the availability of high density brine. Therefore, we drew almost half (48 percent) of the sample from this zone. The south zone comes under the jurisdiction of Surendranagar district. The north zone, coming under the jurisdiction of Patan district, remains as the second largest area of salt production in the LRK. The sample size of north zone accounts for almost 25 percent of the total sample. The North West zone covers the Adeser part that comes under the administrative area of Kutch district and the South West zone, that is, Maliya side, comes under the jurisdiction of Rajkot district; in these two zones the sample size comes to 17 and 12 percent respectively. In these two zones, the density of brine is relatively low as compared to the South zone. The distribution of the sample households across salt zones is presented in Table 1.4.

Table 1.4 : The Sample distribution (Agariyas) across different Salt Zones of the LRK

Salt Producing Zones	Sample	Percent
South East zone (Kharagodha side)	101	48
North East zone (Santalpur side)	49	23
North West zone (Adeser side)	35	17
South West zone (Malia side)	25	12
Total	210	100

Source: Primary Survey

An assessment of the products extracted from the LRK brine for improving the livelihood of Agariyas has been carried out based on the lab tests of subsoil brine. The chemicals found in the LRK brine are again classified as those extracted at the farm level and otherwise. A lab test of salt from different locations of LRK has also been conducted for assessing impurities associated with salt produced in those areas. A semi-structured interview schedule was used to collect data from the households during the salt season of 2011-12. Descriptive statistics and regression techniques have been used for analysing the data. A Cobb Douglas production function has also been employed to analyse the input-output relations of salt production. A return to scale estimation also has been arrived at, using this production function. In addition, we have made an attempt examine the externalities arising out of salt production in terms of potential threats to wildlife, particularly to wild ass. By way of comparing the technical and economic issues associated with the traditional methods of salt production with the scientific methods, the study has suggested modifications in the traditional methods for augmenting the livelihood possibilities of Agariyas. This has been done by giving directions on how to remove impurities of salt at the farm level which, in turn can fetch a good price in the market. Secondly, suggestions have been made with respect to methods on extracting potential chemicals such as $CaSO_4$ $2H_2O$, Carnellite and $MgCL_2$.

1.9. Chapter organisation

This report is divided into five chapters in addition to the introductory chapter. The second chapter deals with the socio economic characteristics and multidimensional poverty Agariyas in the LRK. The third chapter focuses on techno-economic aspects of common salt production. The fourth chapter highlights significance of extracting non-common salts (by-products) as an additional source of income for Agariyas. The fifth chapter deals with the main issues related to biodiversity conservation and livelihoods concerns followed by a summary and concluding views including some policy recommendations in the sixth chapter.

Chapter-II

Multi-Dimensional Poverty of Salt Pan Workers

2.1. Introduction

The manufacturing of salt in the Bombay state of pre-independence India had been going on from time immemorial with more than five hundred salt producing units operating existing along the west coast of India. The industry contributed a substantial revenue to the Pashwas and the British rulers. Inland salt production was also part of this industry, mostly concentrated in the borders of Bombay state and in the Little Rann of Kutch (Aggarwal, 1936). The Lesser or Little Rann, 40 miles east of Greater Rann, joins the main sea at Hansthal creek. Historically, salt was manufactured in this area through a natural brine obtained from the wells dug into the Rann across soft deposits of gravel and clay, gypsum, black soil and mud. The deposits varied in many places, but generally an area of about 25 to 30 feet in thickness lied over the bottom of the old Gulf. The salt production cycle in this area was from December to May 15th. (Aggarwal, 1936). It was a traditional activity practiced mostly by Chunvaliya Koli community[3] of Dhrangadhra region. They had specialised in salt production from the very early days (Bharwada and Mahajan, 2008). It was a family occupation in which women and children participated actively. However, sometimes, they also worked as wage laboures in the state owned salt pans, while engaged their own production. Infact, salt production symbolised the identity of the producer as well as workers. The communities involved in the salt production in the Little Rann of Kutch were historically identified as Agariyas. Their contribution was recognised by the state as evident from the royalty they paid to the government for producing salt. But, the colonial government imposed various types of production and trade restrictions on salt production during the pre-independence period that affected their livelihoods and as a result, they became vulnerable to poverty and deprivation. This situation is still continuing due to various reasons such as the failure of state interventions, market imperfections and natural risks. As a prelude to these issues, the present chapter gives an account of their socio economic status based on both primary

[3] De-notified Tribes (DNTs), also known as Vimukta jati, are the tribes that were originally listed under the Indian Criminal Tribes Act of 1871.

and secondary data. Here, we try to explain the demographic characteristics, occupational structure, assets and poverty levels, using a multidimensional poverty frame work. Here, we argue that the traditionally poor Agariyas have been in a low level poverty equilibrium trap, despite a long history of their occupation.

2.2 Salt Pan Workers

Salt pan workers, belonging to a single occupational category called Agariyas, come from different religious and caste groups. Around 60 per cent of the population belongs to Hindu religion, while the remaining belongs to the Muslim community. The Chunwaliaya Koli community is the dominant caste group, accounting for around 60 per cent of the population. Other caste groups include Darbar, Miyana, and Ahir etc. Most of the Agariyas come under the social category 'other backward communities'. It is estimated that approximately 15000 families migrate to the LRK every year for producing salt. The average household size of Agariyas within the LRK comes to around 6 with small variation across different salt zones; It is 6 in the south east, 5.5 in the south west zones, while 6 in the north east and 5.5 in the North West zones. This indicates, that most families are medium families consisting of father, mother and children. It is very rare that old age dependents accompany them while migrating to the LRK. An age wise classification shows that 13 per cent of the migrating population consists of small children falling under the age group of less than 6 years. The school going age category constitutes around 19 percent of the population. The old age population, above 60 years of age, comes to around 2 per cent (Table 2.1). The old age population usually remains in villages due to extremely harsh climatic conditions of the desert.

Table 2.1 : Distribution of Agariyas across different regions according to age group

Salt Zones	1_6	7_14	15_18	19_60	61 & Above	Total population
South East	86 (13)	124(19)	94(14)	347(52)	13(1)	664(100
North East	46(15)	53(18)	36(11)	163(54)	3(1)	301(100)
North West	28(15)	46(24)	25(12)	91(47)	3(1)	193(100)
South West	6(4)	21(15)	20(14)	88(64)	3(2)	138(100)
Total	166(13)	244(19)	175(13)	689(53)	22(2)	1296(100)

Source: Primary Survey

Migration of Agariyas with family members has a severe impact on children's education and literacy levels; it is found that 45 percent of the Agariyas are illiterate while 7 percent are functionally literate. Almost 31 per cent of Agariyas are found have studied up to the level of primary school and 12 percent up to the level of middle school, while a few

Agariyas studied up to matriculation and intermediate levels. Out of the whole they are educationally backward (Table 2.2).

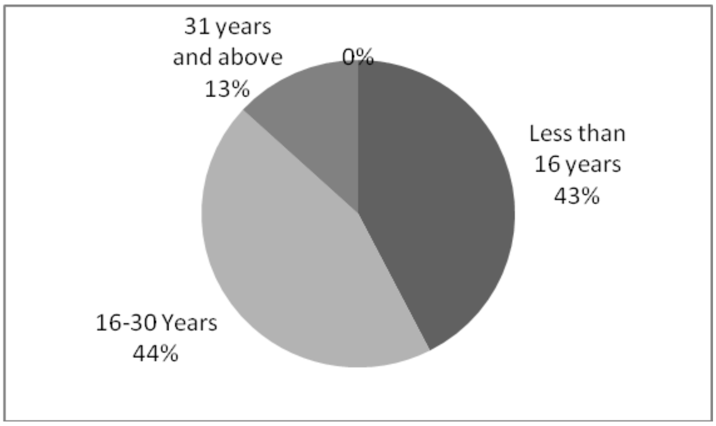
Table 2.2: Educational levels of Agariyas across salt zones

Salt Zone	Illiterates	Functional Literate	Primary	Middle	Matriculate	Intermediate
South East	263	18	236	64	14	7
	(43.62)	(2.99)	(39.14)	(10.61)	(2.32)	(1.16)
North East	114	31	56	39	13	4
	(44.02)	(11.97)	(21.62)	(15.06)	(5.02)	(1.54)
North West	88	24	27	17	6	2
	(53.66)	(14.63)	(16.66)	(10.37)	(3.66)	(1.22)
South West	61	5	42		2	0
	(45.52)	(3.73)	(31.34)	(16.42)	(1.49)	(0.00)
Total	526	78	361	142	35	13
	(45.34)	(6.72)	(31.12)	(12.24)	(3.02)	(1.12)

Source: Primary Survey

One of the reasons for the educational backwardness of Agariyas is perhaps their involvement in salt pan work right from childhood onwards. The school drop outs are quite high in number, as most of them help their parents in salt production. The distribution of the Agariyas based on age at which they started salt pan work is provided in Figure 2.1, which shows that 45 percent of them started salt pan work when they were below 16 years of age. Child labour is still quite high in the salt production areas.

Figure 2.1 : Age wise workforce of saltpan workers



Source: Primary Survey

At present, the main workforce is constituted by 66 per cent of the population in the age group of 15 to 60. Nevertheless, a large number of children in the age group 7 to 14 are also involved in salt pan works, adding another 19 percent to the workforce, an unaccounted part of the workforce, because Agariyas do not consider their children's involvement in salt production as child labour, rather a help to parents. Women in the LRK are relatively few in number as compared to men. Most of the women and children remain in the LRK from September to March and then start going back to their villages when the hot summer sets in during April and May. But, those women involved in the harvesting of salt, stay back, mostly young ones. The estimated female sex ratio comes to around 805 per thousand men in the LRK (Table 2.3).Although across all the four zones, the ratio is more or less the same, the south west accounts for the lowest female sex ratio, while the highest by the north east .

Table 2. 3: Distribution of Agariyas population and sex ratio across different zones

Zones	Total Male	Total Female	Total Population	Sex Ratio
South East	370	294	664	795
North East	162	139	301	858
North West	104	89	193	856
South West	82	56	138	683
Total	718	578	1296	805

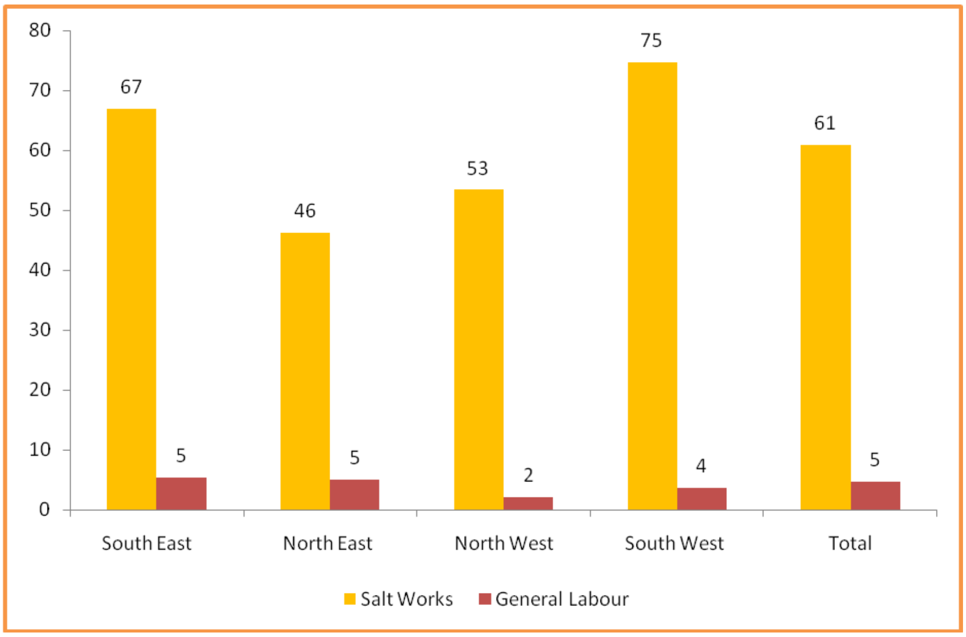
Source: Primary Survey

The average experience of an active salt worker is 26 years in the LRK. The average experience of a salt worker in South east zone is 32 years, while it is 30 in South west zone, 16 in North east zone and 17 in North West Zone. It is clear from the data that the people learning salt production from their parents constitute around 79 percent of the population. It varies across the zones: a higher percentage of people learning salt production from their parents in South east zone and South west zone i.e. around 94 and 92 respectively, while a lower percentage is observed in North east zone and North West Zone, i.e., around 47 and 69 respectively. This is a clear indication that salt production has been a traditional family occupation in the LRK. The techniques and know how are transferred through generations. . Moreover, the involvement of women and children in salt production indicates that it is a family based livelihood activity for survival. However, children's involvement in salt production has a severe impact on literacy and educational levels in terms of temporary school drop outs. This is one of the serious issues that needs an immediate action.

2.3 Main occupation

Main occupation is defined as the occupation which provides the largest share of individual income. We have already seen that 66 percent of them are productively employed of which 61 percent of Agariyas have reported salt production as their main source of income, while the remaining 44 percent of the population remain without occupation and no income; they constitute dependents children and old age people. Since salt production spreads over only eight months, Agariyas need to find employment the remaining four months. During this period, they engage themselves in different activities such as own cultivation, wage labour and other works. A zone-wise classification of the main occupation of Agariyas is provided in Figure 2.2.

Figure.2.2: Distribution of Agariyas population across different regions based on their main occupation



Source: Primary Survey

Approximately 7 percent of the Agariyas are involved in cultivation and 84 percent in wage labour during off seasons. Among the wage labourers, people engaged in the agriculture sector as labourers account for only 14 per cent, while 65 per cent take up general works and 5 percent work in salt producing industrial units. We also have noted during the survey that around 9 percent opt for unspecified works. (Table 2.4).

Table 2.4 : Distribution of people by employment during off season

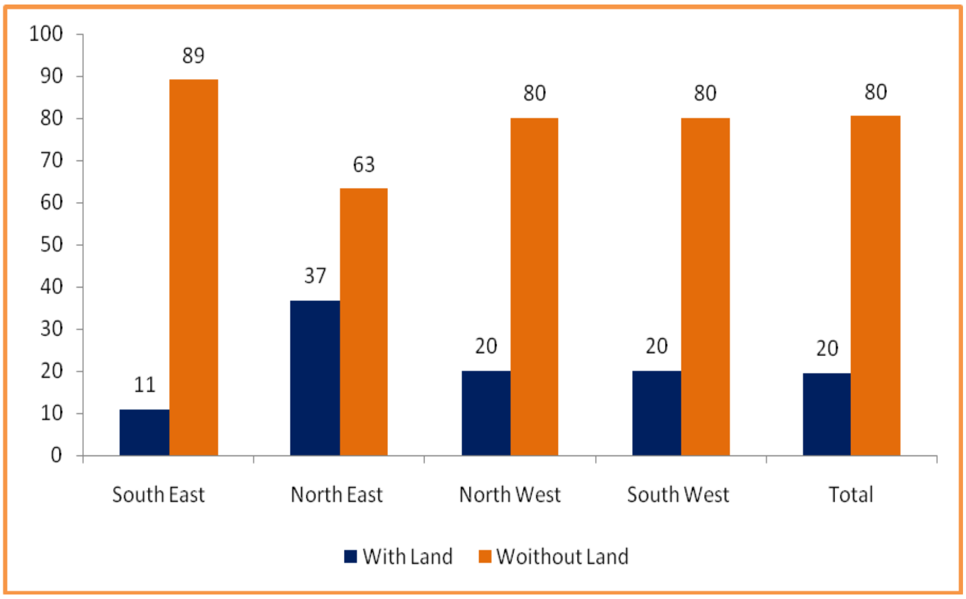
Salt Zones	Cultivation	Agriculture labour	General labour	Labour in salt units	Other works	Total
South East	15	48	293	34	6	396
	(3.79)	(12.12)	(73.99)	(8.59)	(1.52)	(100)
North East	23	10	20	0	36	89
	(25.84)	(11.24)	(22.47)	0	(40.45)	(100)
North West	2	14	37	0	20	73
	(2.74)	(19.18)	(50.68)		(27.4)	(100)
South West	3	15	64	0	0	82
	(3.66)	(18.29)	(78.05)	0	0	(100)
Total	43	87	414	34	62	640
	(7)	(14)	(64.69)	(5.31)	(9.69)	(100)

Source: Primary Survey

2.4 Ownership of agricultural land

Land and livestock are the most important assets in respect of the rural economies. In the case of Agariyas, only 20 percent of them own productive land, while the remaining 80 percent are land less (Figure 2.3)among the 20 percent land owners, the average holding works out to 8.25 acres per family for cultivation. A zone-wise distribution of land holdings shows that Agariyas in north east (Santalpur) has account for the largest average holding of 10.76 acres per family. The North West (Adeser) and South west (Maliya) share the smallest average holdings i.e., 4.14 and 6.74 acres respectively. The Agariyas in south east (Kharagodha), hold an average holding of 7.44 acres per family. Among the land owning class, we have found only 56 percent of them having titles over their ownership right. Since 80 percent of do not own any private land, they try to take out their livelihood through salt production. Moreover, it is important to note that 24 percent of the land owned by Agariyas is kept fallow due to the fear of raiding by wild animals from the LRK. It is also found that Agariyas generally keep less livestock with them since they are a migrant population. In the absence of sufficient land and livestock, they depend up on salt production for their subsistence. This is to be taken as an important reason for their high dependency on common property resources like the LRK for alternative source of livelihoods (salt production).

Figure 2.3 : Distribution of Agariyas across zones on the basis of land ownership



Source: Primary Survey

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There are issues with respect to land rights of the Agariyas in the LRK after the formation of Wild Ass Sanctuary that remain unsettled (Bharwada and Mahajan, 2008).

2.5 Multidimensional Poverty

Poverty is generally measured in terms of consumption expenditure on food and non-food items. However, there are recent attempts made at estimating poverty by taking into account various other dimensions of household wellbeing proposed by the Oxford Poverty & Human Development Initiative (OPHI) researchers.This method of estimation of poverty is based on the theoretical views of Amartya Sen. For simplicity, this study uses original symbols and notation as used by the authors in their original work. Suppose there is a society with N households and D dimension of poverty. Let X denote the set of all $N \times D$ matrices and $x \in X$ represents an achievement matrix of a society, where x_{nd} is the achievement of the nth household in the dth dimensions for all d=1,……,D and n=1,……,N. The nth row and the dth column of X X are denoted by $x_n=(x_{n1},\ldots\ldots,x_{nD})$ and $x_{.d}= (x_{1d},\ldots\ldots,x_{Nd})$. The row vector x_n. summarizes the achievements of household n in D dimensions; whereas, the column vector $x_{.d}$ represents the distribution of achievements in the dth dimension across N households. Let z to be the D-dimensional deprivation cut-off vector z where the deprivation cut-off for the dth dimension is indicated by zd. Corresponding to any x X, an N x D dimensional deprivation matrix g^0 is constructed, where the n_dth element is denoted by g_nd^{0}. Any element of g^0 can take only two values as follows:

$$g_{nd}^{0} \begin{cases} 1 \text{ if } x_{nd} < z_d \\ 0 \text{ if } x_{nd} \geq z_d \end{cases} \qquad (3.3)$$

In other words, the n_d^{th} entry of the matrix is equal to one when the nth household is deprived in the d^{th} dimension and is equal to zero when the household is not deprived. From matrixg 0, is an N-dimensional column vector C of deprivation counts such that, the n^{th} element $c_n=|g_n{}^0|$ represents the number of deprivations suffered by the n^th household? If the dimensions in X are cardinal, then a normalized gap matrix g^1 will be constructed, where the n_d^{th} element is:

$$g_{nd}^{1} \begin{cases} (z_d - xd)/z_d \text{ if } x_{nd} < z_d \\ 0 \text{ otherwise} \end{cases} \qquad (3.4)$$

By construction, $z_{nd} \in [0,1]$ for all n and all d, and each element gives the extent of deprivation experienced by the n^{th} household in the d^{th} dimension. The generalized gap matrix is denoted by g^{α}, with $\alpha>0$. The nd^{th} element of g^{α} is denoted by $g^{\alpha}{}_{nd}$, which is the normalised poverty gap raised to the power α. Now a household is said to be poor if the household is deprived at least k dimensions where k=1,……,D. Suppose ρk such that $\rho k\ (x_n.,z)=1$ if$c_n>k$ and $\rho_k(x_n.,z)=0$ if$c_n<k$. It implies that a household is identified as multidimensionally poor if the household is deprived in at least k number of dimensions. Now multi-dimensionally headcount ratio (H) is defined as Q/N where Q is the number of individuals in set Z_k. However, it does not capture the household's individual level of deprivation. Thus, Adjusted Head Count Ratio (M) is defined as the total number of deprivations experienced by poor households divided by the maximum number of dimensions that are possibly experienced by all households. It can alternatively be defined as a product of the per cent of multi-dimensionally poor (H) and average deprivation share of households (A) where average deprivation share is defined as the number of deprivations experienced by poor households divided by the possible number of deprivations that can be experienced by all poor household. Some of the indicators considered for estimating poverty are presented in Table 2.5

Table 2.5: Indicators Used for estimating Multidimensional Poverty of Salt Pan Workers in LRK

Sl. No	Indicators
Economic	
1	Operational land holdings
2	Type of house
3	Number of rooms in the house

4	Cooking fuel
5	Consumer durables
6	Calorie intake
7	Ratio of food expenditure to non food Expenditure
8	Indebtedness
9	Borrowing for consumption purpose
Social -demographic	
1	Female headed households
2	Dependency ratio
3	Incidence of Child labour
Health	
2	Hygiene
3	Persistence of illness
4	Labour days loss due to illness
Security	
1	Land tenural security (land title)
2	House tenure (Own houses)

2.6 Identification of Poor

Households exhibit different characteristics and behavioural patterns. Thus, it is difficult to identify a common criteria or a single indicator of deprivation. Therefore, we have taken indicators representing four dimensions of poverty namely economic, social, health and security. The indicators identified under these dimensions are provided in table 2.5. A cut-off point to each of the indicators, based on certain criteria developed in the literature, has been assigned for identifying deprived households. The indicators are classified as qualitative and quantitative for assigning scores based on the cut-off points. In the case of qualitative indicators such as type of house, incidence of child labour, we have assigned 1 if a household falls below the cut-off point, otherwise 0. In the case of quantitative variables, if a household is below the cut-off point, the score is estimated by dividing the difference between a chosen value and the actual value by a chosen value, otherwise 0. The scores are aggregated at the household level for constructing an index that shows the level of deprivation. Further, a cut-off point has been fixed to separate the poor and non-poor households. A household is considered to be poor if the index falls above the cut-off point.

Land is one of the important sources of livelihood. An operational land holding includes the total amount of land cultivated in a year. The cut-off point is decided if a households operational land holding is less than or equal to one acre. More than 80 percent of the people are land less. Among the land owning class (20 %), most of them are small and marginal land holders. In the absence of private land holdings, they depend the LRK for their livelihoods where the right to use the land is de facto. Thant means, a majority of Agariyas are poor in terms of operational land holdings. The second dimension of poverty is the type of houses they have in their villages. All families with kutcha houses have been classified as poor in the analysis. A standard norm for adequate room availability is three adult members per room. Therefore, a household is considered as poor if the number of available rooms is less than one-third of the total adult members. The main fuel sources used for cooking are fuel wood, cow dung, kerosene and LPG. Empirical evidences show that as income grows people changes their cooking practice from fuel wood to dung cake to kerosene to lastly LPG. Thus, a household is said to be poor if it is using fuel wood and dung cake as the main sources of fuel wood. Those households using either of these two sources and also LPG are considered non-poor in the analysis. Movable assets of a household include many items varying in values. Thus, all assets are categorized into two groups based on their respective values. Households coming under a low value category have been considered poor in the analysis. Households' food consumption is also taken into account while estimating poverty. The minimum calorie intake per day per person as decided by the NSS 61st Round during 2004-05 is 2700 (Table 2.6). Thus, a person is considered to be poor if his/her per day calorie consumption is less than 2700. The total amount of calorie intake of each household is calculated by converting each food item into calories by using the criteria as mentioned in table 2.6. Then the aggregate calorie content of each food item gives us the monthly calorie intake of each household. The daily calorie intake is calculated by dividing monthly calorie intake by 30 and the number of consumer units of the respective households. Households with members consuming food below the minimum calorie intake norm are considered as poor. In addition, a ratio of non-food to food expenditure also has been worked out to characterise poverty. In this respect, if a household's food expenditure is two times the non-food expenditure, it is treated as poor.

Table 2.6: Calorie intake per day per person as decided by the NSS 61st Round during 2004-05

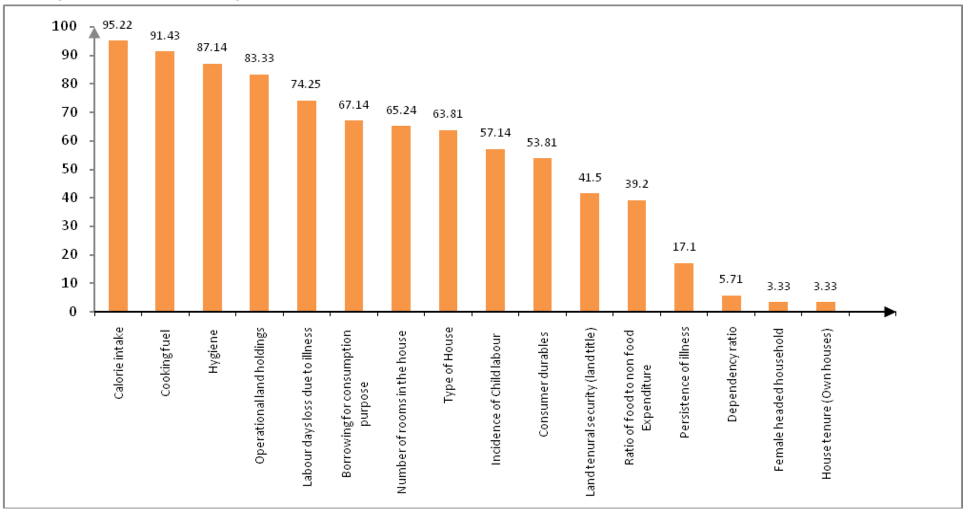
Sl no	Food items	Unit	Coloric
1	Rice	Kg	3460
2	Wheat	Kg	3410
3	Other cereals	Kg	2615

4	Pulses	Kg	3450
5	Milk	Ltr	1000
6	Vegetables	Kg	550
7	Leafy vegetables	Kg	260
8	Fruit and nut	Kg	520
9	Sugar and sweet	Kg	3980
10	Egg	Nos	100
11	Mutton	Kg	1180
12	Chicken	Kg	1090
13	Fish	Kg	1050
14	Biscuit/pickle	Re	48.1
15	Salt	Re	46.1
16	Tea	Kg	0
17	Coffee	Kg	0
18	Cooking oil	Kg	9000
19	Pan	No	2.2
20	Cigar	No	380
21	Other		100

Source: NSSO (2004-05

Unpaid borrowing (Indebtedness) is an important characteristic of some of the households and hence, households with unpaid outstanding loan amounts have been considered poor. Moreover, poor households' income levels make it difficult to meet their daily consumption needs. They frequently borrowing from neighbours or money lenders to meet their consumption needs is considered an important characteristic of poverty. Therefore, households are treated poor if they meet their consumption needs through frequent borrowings. The analysis has considered three socio-demographic variables- female headed households, dependency ratio and child labour, If a household head is female, they are more vulnerable to poverty; thus, we have considered all households with female heads as poor in the analysis. Secondly, if the total number of children and old age members outnumber the total number of working adult population, the household is considered poor. Thirdly, a child in the LRK is considered a labourer if he/she is not a student working in a salt pan. A household is said to be poor in the analysis if it has at least one child labourer.

Figure 2.4 : Percentage of households found deprived in terms of various indicators of poverty



Source: Primary survey

As far as health is considered, we have taken hygiene, persistence of illness, and labour days lost due to illness as indicators of poverty. In the LRK, people generally use water, mud and soap for cleaning their hands after defecation. Thus, a household is said to be poor if its members clean their hands after defecation with mud. Poor people are also prone to various illness and can't afford expensive treatments because of their low income levels. Thus, they suffer for a long period of time due to illness and are unable to contribute positively to the labour force. The average human days lost in a season due to illness comes to 12 per household. Thus, a household is said to be poor if it loses more than 12 man-days in a season. Finally, households reporting the persistence of health related problems post treatment are also considered poor. As far as security is considered, land and house tenure security is decides poverty. Households without land titles and house ownership are considered poor in this case. The results of a poverty analysis are provided in table 2.7. Among the poverty related variables, we find more number of people poor in terms of calorie intake, cooking fuel, hygiene, labour days lost due to illness and borrowing for consumption purposes. The type of house and incidence of child labour come next. Households, poor in terms of a minimum of 6 dimensions of poverty, are defined as people living below the poverty line, accounting for around 78 per cent of the total population (Table 2.7). The analysis reveals that the current BPL estimates of the government exclude many poor people who remain deprived in terms of these 6 dimensions. Around 65.71 percent of the households are living below the poverty line as per the government estimates as against 75.76 percent based on the primary data. In this context, it is to be noted that the high dependency on the LRK for livelihood is due to a high level of poverty.

Table 2.7 : Estimation of poverty based on the new approach

Deprivation Index (DI)	Own Estimation		Based on BPL Census			
			BPL		APL	
	Number	Percent*	Number	Percent	Number	Percent
14	1	0.48	1	100.00	0	0.00
10	4	2.38	4	100.00	0	0.00
9	13	8.57	8	61.54	5	38.46
8	55	34.76	29	52.73	26	47.27
7	58	62.38	40	68.97	18	31.03
6	33	78.10	25	75.76	8	24.24
5	25	90.00	16	64.00	9	36.00
4	11	95.24	9	81.82	2	18.18
3	7	98.57	5	71.43	2	28.57
2	2	99.52	1	50.00	1	50.00
1	1	100.00	0	0.00	1	100.00
Total	210		138	65.71	72	34.29

Source: Field Survey

* Cumulative percentages

2.7 Summary and Conclusion

This chapter examined the socio economic aspects and poverty levels of salt pan workers using primary data collected from the LRK. The estimates of poverty reveals that a high incidence of multidimensional poverty is associated with high illiteracy levels. With respect to the poverty related variables, we have noticed that that a large number of people are poor in terms of calorie intake, cooking fuel, hygiene, labour days lost due to illness. The involvement of women and children in salt production indicate that it is a family based livelihood activity for survival. More importantly, children's involvement in salt production has serious implications for literacy and education in view increased (though temporary) school drop outs, an issue which needs to be seriously addressed at the policy level.

Chapter-III
Common-Salt Production

3.1. Introduction

It has already been noted in chapter II that a multidimensional poverty is very high among salt pan workers. Almost 78 percent of the people are facing a high level of poverty in terms of inadequate food, education, health, housing, sanitation and drinking water,while entirely depending on seasonal salt production in the LRK for their livelihoods. They face various livelihood threats from the market and nonmarket forces. Some of the major identified livelihood risks include unexpected rains, declining brine yields, fatal gases from the wells and high velocity winds during the course of salt production. The market imperfecctions as well as price volatility also create risks while selling the output on time. An eviction risk from the salt zones for biodiversity conservation also creates a sense of fear of a permanent loss of livelihood sources. In this context, it is important to find a solution for the livelihood security of Agariyas without compromising on the biodiversity conservation objectives of the area. It is an issue of ensuring Agariyas' livelihood options and security without compromising on the biodiversity conservation. The techno-economic aspects of improving the quality of common salt and risks aversion in the production and marketing of salt merits a greater attention in this respect. Therefore, the techno economic aspects of improving the quality of salt is analysed in this sectionby way of examining the composition of chemicals in the subsoil brine, traditional methods of salt production, seasonality, issues related to output maximisation, input-output relations and returns to scale. The issues related to the market and the value chain of common salt along with associated risks are discussed in the last part of this chapter.

3.2 Salt Season and Migration of Agariyas

The salt season in the LRK starts in August or September depending up on the monsoon and ends in May (Figure 3.1). It is a labour intensive activity with a high proportion of family labour and hence, they migrate to the LRK with the maximum number of family members including women and children. They migrate to the same salt zone and stick to the same salt pan location for salt production. It is very rare that they move from one location to another in view of uncertainties over the availability of brine that might create an additional cost of production.

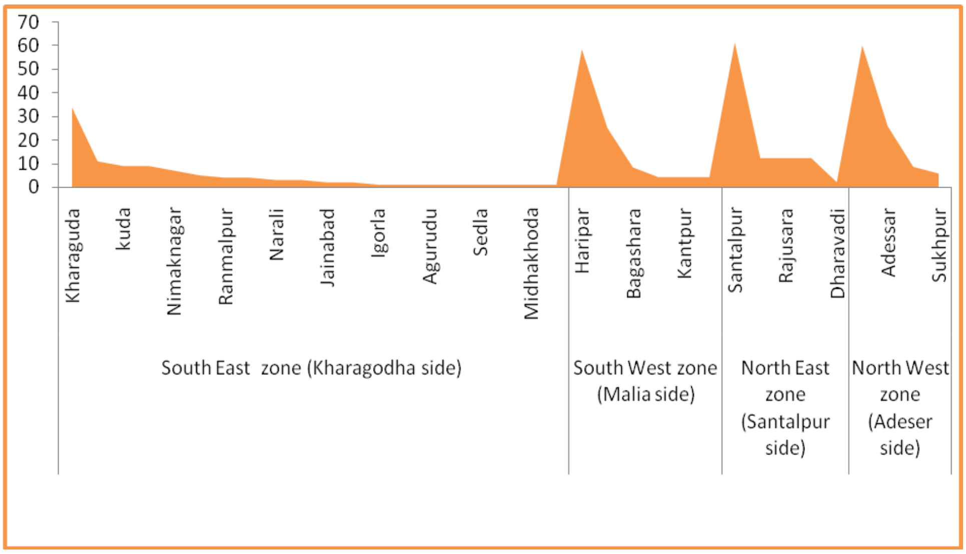
Figure 3.1 : Traditional Salt Production Calendar

Source: Focus group discussions (FGDs)

The sample distribution of Agariyas across different salt zones based on the origin of their migration (villages) is provided in figure 3.2.South East zone is the largest among the four zones in terms of area and salt production.

The migration process starts just after the monsoon season during August-September depending on the end of the monsoon season. During this period, the LRK starts turning from its wetland condition into dry land. Migration to the South Eastern and South Western parts might get delayed since these are low laying areas that take more time to dry up. They migrate with a variety of equipments necessary for producing salt. such as crude oil pump, Dantala and Pavdi.These are carried in camel carts, tractors or a three wheelers called chhakdas. The selection of the mode of transport depends on the wet conditions of the LRK during the post monsoon period. Sometimes, migrants walk to the desert with all the equipments if it is in a marshy condition. Distances to salt pans from the nearby villages also vary across different salt zones.These characteristics clearly indicate the traditional nature of salt production which is labour intensive with ahigh proportion of family labour, and the use of traditional equipments and techniques.

Figure 3.2 : Percentage distribution of Agariyas across different salt zones based on the origin of their migration (villages)



Source: Sample Survey data

3.3 Chemical Composition of Subsoil Brine

The main natural resource for salt production is subsoil brine. A laboratory test done on the quality of subsoil brine from different salt zones in the LRK for a understanding of the brine density and chemical composition shows that the average density of brine in the LRK is 17° Be (Table 3.2), much higher than the sea water density that comes to around 3°Be.This means the LRK brine is more than 5 times the density of sea brine. A high density is an important advantage for producing salt from the subsoil brine. An important observation made in respect the chemical composition reveals that17°Be concentration is a level at which calcium sulphate ($CaSO_4 2H_2O$) begins to separate out as a layer on top of the brine before settling down in a bottom corner. A major portion of $CaSO_4$ gets separated out at 17^0 to 25^0 Be, a crucial production stage that determines the purity of sodium chloride (NaCl). The precipitation of calcium sulphate depends on the quantity of sulphate present in the brine. The presence of sulphate is important to expedite a rapid production and a high quality sodium chloride. But the brine from different wells in the LRK shows a certain level of sulphate deficiency in comparison to

Table 3.2 : Chemical Analysis of brine from different locations in the Little Rann of Kutch

Sample No	Salt Zones	In Ionic Units					In Probable Units					
		Specific Gravity	Ca	SO4	Mg	Cl	CaSO4	MgSO4	MgCL2	NaCl	oBe'	Location within Salt zone
1	South East	1.147	0.150	0.660	1.090	14.060	0.509	0.377	3.972	18.309	18.583	Halvat
2	South East	1.114	0.148	0.720	0.730	10.510	0.502	0.457	2.499	14.263	14.838	Halvat
3	South East	1.170	0.282	0.980	1.060	16.860	0.957	0.382	3.850	23.076	21.068	Halvat
4*	South East	1.090	0.190	0.610	0.560	8.210	0.644	0.194	2.040	11.034	11.972	Kharaguda
5	South East	1.144	0.268	0.700	0.960	14.090	0.909	0.074	3.700	18.692	18.252	Kharaguda
6	South East	1.124	0.296	0.710	0.700	11.930	1.004	0.002	2.738	16.311	15.996	Dragadra
7	North East	1.134	0.220	0.550	0.810	12.670	0.746	0.030	3.147	17.029	17.134	Santalpur
8	North East	1.158	0.070	1.670	1.610	13.740	0.237	1.878	4.831	16.726	19.784	Santalpur
9	North East	1.128	0.230	0.560	0.710	12.320	0.780	0.012	2.769	16.916	16.454	Santalpur
10	North East	1.147	0.310	0.790	0.810	14.020	1.052	0.061	3.123	19.285	18.583	Santalpur
11**	North East	1.063	0.110	0.390	0.540	5.750	0.373	0.159	1.989	7.039	8.594	Santalpur
12	North West	1.162	0.110	0.780	1.280	15.410	0.373	0.646	4.504	19.881	20.215	Adeser
13	North West	1.155	0.150	0.620	1.160	14.810	0.509	0.327	4.285	19.161	19.459	Adeser
14	North West	1.134	0.200	0.560	0.890	12.780	0.678	0.102	3.404	16.896	17.134	Adeser
15	North West	1.125	0.180	0.640	0.850	11.960	0.611	0.262	3.122	15.889	16.111	Adeser
16	South West	1.164	0.241	1.050	0.940	15.940	0.817	0.592	3.216	22.337	20.430	Malya

Source: Collected from field during March - April 2011

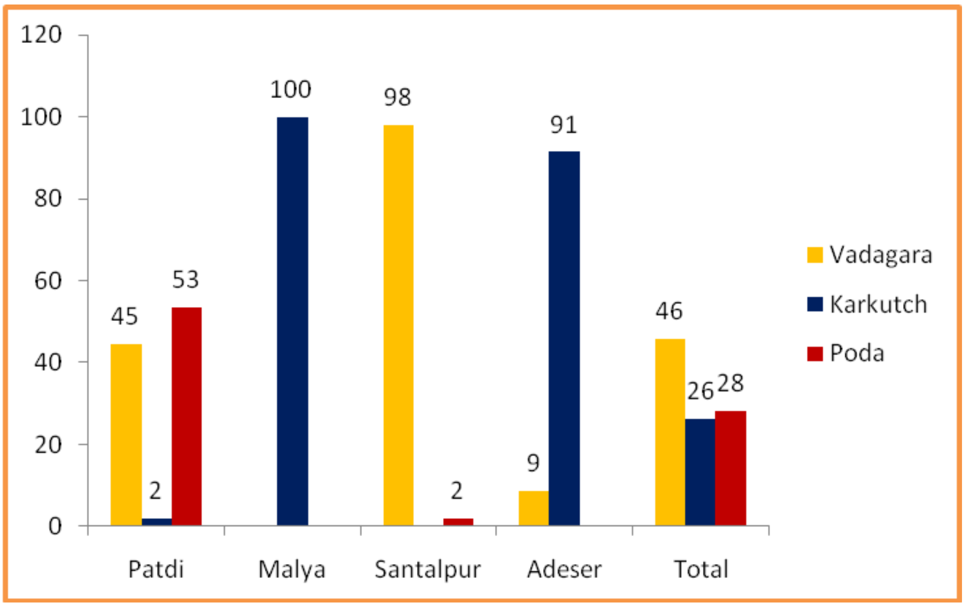
Notes: Sample number 4 is the initial brine and sample number 11 is the initial low density brine; * initial brine from the well; ** initial low density brine.

the sea brine. The brine sample (Number 16) from Maliya (South West Zone) has a reasonably high level of sulphate that helps calcium sulphate precipitate faster which, in turn, gives a relatively better quality common salt as compared to other salt zones. Another sample (Number 8) from Santalpur also shows a high level of sulphate, but all the other samples of Santalpur indicate a low level of sulphate, which is the case with almost all parts of the LRK. Due to a low level of sulphate presence in the LRK brine, the precipitation of calcium sulphate ($CaSO_4$ $2H_2O$) gets delayed. Sometimes, it crystallises simultaneously with sodium chloride, adding impurities to it,in the process this is one of the crucial issues requiring to be addressed for improving the quality of NaCl.

3.4 Types of Common Salt

Agariyas produce three varieties of common salt, using the traditional method of solar evaporation. These are locally called Vadagara,Poda and Karkachh. Vadagara is the dominant single variety of salt produced in the LRK(Bada = big, Agar = pan). The crystals of the Vadagara type of salt are relatively big and hard. This variety is restricted to a single yield in a season. Approximately 45 percent of the Agariyas (most of them live in NE and SE zones) have reported their preference to produce Vadagara variety of salt.

Figure 3.3: Distribution of Agariyas engaged in different kinds of Salt Production



Source: Based on primary survey data

The method used in the production of Poda variety of salt is only slightly different. The Poda variety is smaller in size as compared to Vadagara. This variety gives maximum two crops in a season. The sample data shows that nearly 28 percent of the Agariyas are engaged in the production of Poda variety. But many of the Agariyas opt for a single crop of Poda due to a high risk of losing the product at the end of the season to heavy winds. The Karkachh variety smallest in size, is produced in areas proximate to the sea, mostly in south west side of the LRK (Maliaya). The Karkachh variety gives multiple crops in a season. The sample data shows that nearly 26 percent of the Agariyas are engaged in the production of this variety. The distribution of Agariyas engaged in the production of different varieties of salt is provided in Figure 3.3. The figure clearly shows Agariyas' preference to Vadagara type of salt production, which is big in crystal size. Different lab tests have confirmed the presence of high impurities in this variety as compared to Karkachh and Poda varieties. Therefore, the promotion of Karkachh has been suggested as a solution to improving salt quality and there by the livelihoods of the people. This aspect is discussed in detail in the later part of this chapter.

3.5 Cost of Production

The cost of materials and fuel used in salt production and labour cost constitute to the total cost of production. It has already been noted that Agariyas migrate to salt pans with all the required materials for salt production and building temporary huts in the LRK. They take materials to the LRK on head, bicycle or motorcycle. The transportation of materials, using both hired labour and family members, constitutes a small part of their production cost in terms of labour time. The transportation of materials and settling down near the salt pan take about a week's time. The estimated average labour cost including family labour for material transportation and settling down comes to around Rs 1257 in a year which is approximately 1.44 per cent of the total cost of labour.

After settling down, they reopen their wells for pumping out the brine. The location of wells is marked at the end of every season for easy identification. Additional wells are dug whenever there is an acute scarcity of brine. Digging of wells is a risky task for male members due to the release of different fatal gases from wells sometimes leading even to death[4.] The estimated labour cost of re-opening a well including family labour works out to Rs 2923, which is approximately 3.34 percent of the total labour cost. The salt pan condensers are called 'Gama' while crystallisers are called "Pate" in the local language. The size of an average condenser in the LRK measures 100321 square feet. The crystallisers are smaller in size 71574 Square feet as compared to condensers; it is almost 40 per cent of the total area of Gama and Pate. The average labour cost of preparing condensers, crystallisers and bunds of earthen channel in a normal salt pan amounts to Rs 11838, about 13.56 percent of the total labour cost.

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[4] It is reported that Agariyas keep pigeons with them while digging the well as the death of these pigeons help them identify the presence of poisonous gases inside the well.

An earthen channel of 4 feet width conveys the brine to the condensers,while the length of the earthen channel ranges from 6 m to 3 kilometers in some locations of the LRK. The labour cost of Gamda, Pata and earthen channel varies across different salt zones depending on the type of salt they produce. Two equipments, locally called 'Dantala' and 'Pawade', are used for mixing salt. These are made of wood instead of iron to avoid high rusting due to the presence of strong saline water in the area.

Salt mixing activity continues till the end of the season and involves a high cost of labour time. In addition to family labour, Agariyas hire labour for this purpose whenever it is required. The labour cost of salt mixing constitutes 71.47 percent of the total labour cost. But the maintenance cost of equipments used for mixing salt is negligibly low (about Rs 148/salt pan). The cost of production also varies depending on the type of salt(Tables 3.3 and 3.4).

Table 3.3 : Cost of labour for different activities in the production of salt (in Rupees)

Stages of	Kurkach		Poda		Vadagara		All	
products	Family	Hired	Family	Hired	Family	Hired	Family	Hired
Transportation	662 (0.89)	506 (1.98)	408 (0.58)	200 (3.17)	853 (1.37)	632 (3.31)	688 (1.01)	569 (2.94)
Well Opening	2178 (2.91)	727 (2.84)	2438 (3.47)	517 (8.19)	2139 (3.45)	737 (3.86)	2229 (3.28)	694 (3.57)
Pump Installation	556 (0.74)	129 (0.50)	611 (0.87)	49 (0.78)	505 (0.81)	188 (0.98)	547 (0.81)	135 (0.70)
Gamda/Pata/ bunds	8774 (11.74)	3159 (12.36)	10389 (14.77)	2033 (32.21)	8356 (13.47)	2970 (15.56)	9010 (13.26)	2828 (14.62)
Mixing salt	56167 (75.15)	18416 (72.03)	52262 (74.28)	763 (12.09)	5141 4(72.75)	11649 (61.03)	50099 (73.75)	12277 (63.47)
Preventing dust	300 (1.17)		557 (8.83)		579 (3.03)		539 (2.79)	
Salt Removal	5605 (7.50)	1904 (7.45)	3283 (4.67)	1742 (27.60)	4443 (7.16)	2010 (10.53)	4628 (6.81)	1918 (9.92)
Loading	800 (1.07)	425 (1.66)	964 (1.37)	450 (7.13)	613 (0.99)	323 (1.69)	731 (1.08)	383 (1.98)
Total	74742 (100)	25566 (100)	70355 (100)	6311 (100)	62050 (100)	19088 (100)	67932 (100)	19343 (100)

Source: Primary survey data

Protecting salt from dust is an important activity during March - May. Tilling of land around a salt pan is mostly done using tractors with a minimum amount of labour time.

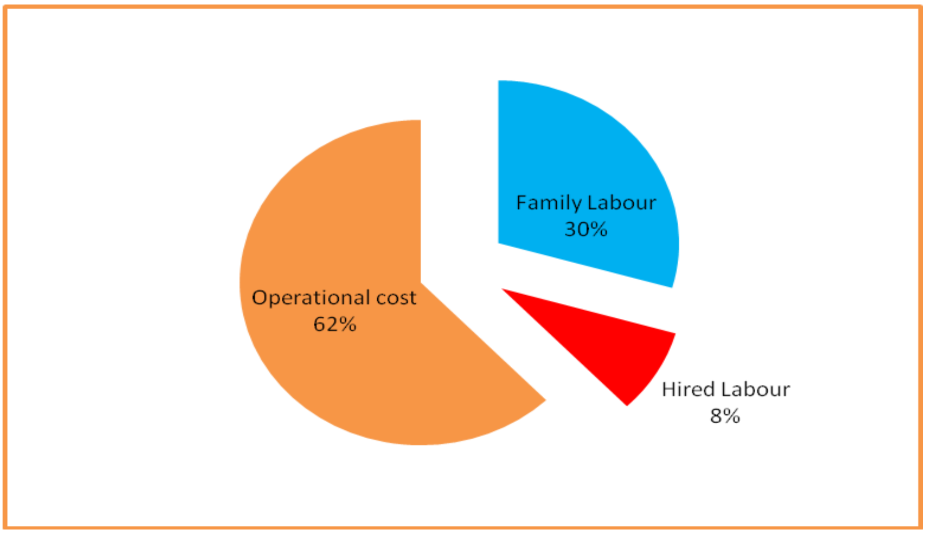
An estimated labour time used for tilling land shows that, on an average, Agariyas incur Rs 539 while, Rs 2099 for tractors. They pay an average of Rs 221 per hour for a total 7 hour work. The time rate paid for tractor use varies across locations ranging from Rs 200 to 350 and the use of time also varies between 1 and 50 hours. The cost of harvesting of salt amounts to around Rs 6546 per salt pan, i.e., 7.5 percent of the total labour cost. It is important to mention that they use additional hired labour during harvesting time. The cost of loading salt works out to around Rs 1114 per salt pan, i.e.,1.27 per cent of the total cost.

Table 3.4 : Cost of Materials used in the production of salt (in Rupees)

Materials	Karkachh	Poda	Vadagara	ALL
Dantala	114(0.12)	91(0.05)	130(0.09)	115(0.08)
Pawada	33(0.03)	36(0.02)	32(0.02)	33(0.02)
Pipe	170(0.18)	196(0.11)	252(0.17)	217(0.15)
Cycle	138(0.14)	273(0.15)	190(0.13)	198(0.14)
Pump	2949(3.08)	4662(2.64)	6522(4.37)	5031(3.56)
Zipta	2280(2.38)	1855(1.05)	3155(2.11)	2557(1.81)
Fuel	90186(94.07)	169167(95.96)	139067(93.12)	133217(94.23)
Total	95870(100)	176280(100)	149348(100)	141368(100)

Source:Primarysurvey data

Figure 3.3: Distribution of the total cost of Salt Production



Source: Primary Survey data

The other costs of production include the costof materials like crude oil, lubricants for running pumps and zipta for crystallisation. While reopening a well, they install a crude oil pump of 5-6 HP at the mouth of the well to pump out the brine. Normally one pump of 5-6 HP capacity is enough for a 10 acre salt pan area. The life of these pumps varies from 3 to 10 years depending on the use. The cost of a crude oil pump at current prices amounts to around Rs 25000 to 40000 depending on the horse power. It is reported that 42 per cent of the pumps used in the LRK are one year or less than one year old. Nearly 46 percent of the pumps are 1 to 10 years old. The remaining 11 percent are above 10 years old. They generally replace their crude oil pumps after 10 years, but pumps above 25 years old are also found with a few people. It is reported that a pump needs 2.5 barrels of crude oil (300 Lt) in a month, on an average, to supply brine to a 10 acre plot of salt pan. One barrel containing 200 litres of crude oil costs Rs 8500. These pumps run continuously throughout day and night supplying brine to the condensers. The cost of fuel alone covers 94 percent of the total operational and maintenance cost. The estimated average cost of maintenance for a pump comes to around Rs 5031 in a year, which is 3.5 percent of the total cost of materials used in salt production. The use of Zipta constitutes only 1.8 per cent of the total operational and maintenance cost. The total operational and maintenance cost works out to around 62 per cent of the total cost of production. The remaining cost is distributed among family and hired labour (Figure 3.3).The use of fixed capital other than crude oil pump in salt production is negligibly low. The distribution of costs across materials and labour shows that crude oil cost for pumping subsoil brine takes a major share followed by family labour. This gives an indication that the cost minimisation strategies in salt production should focus on saving crude oil consumption. Promotion of energy saving production methods and the use of alternative sources of energy can help them reduce the aggregate cost of salt production.

3.6 Output Value

A salt producing area is defined as the total area of condensers and crystallisers. The average salt producing area amounts to 1.66 hectares, While the yield per salt producing area to around 998 tonnes. The average production of salt in LRK works out to1593 tonnes per salt pan. The average yield reported in North East zone and North West Zone is much higher than South East and South West zone. This is attributed to the non-availability of brine in these areas particularly South East zone towards the end of the season. We have that Karkachh producers produce a relatively large quantity of salt since they take multiple crops compared to the other two varieties. The yield of Karkachh averages 1158 tonnes in a year, while it is 834 and 966 for Poda and Vadagara. Vadagara is considered one of the cheap quality salts since it is bigger in size and difficult to iodize; however, most of the Agariyas prefer to produce Vadagara. The price per tonne of Vadagara variety is low compared to Poda variety. The quantity of Karkachh produced per farm is also higher compared to Poda variety,but the price fetched per tonne is lower. The price per tonne of Karkachh variety amounts to Rs 106, while it is 142 for Vadagara and 179 for Poda. A lower price observed of Karkachh in North Western side (Adeser) is attributed to a high transportation cost.

Table 3.5 Average quantity and price of different varities of salt produced during the 2010-11 season across salt zones of LRK.

Salt Zones of LRK	Type of Salt	Crystallizer	Condenser	Total Area	Average Production in tonnes	Yield in tones	Price per tones	Gross Value
South zone	Karkachh	0.39	0.66	1.05	873	829	160	139680
	Poda	0.57	0.81	1.38	1138	826	179	203702
	Vadagara	0.59	0.93	1.52	1161	763	148	171828
	Total	0.57	0.86	1.44	1143	796	165	188595
Malya	Karkachh	0.62	0.91	1.53	1351	880	122	164822
	Total	0.62	0.91	1.53	1351	880	122	164822
North zone	Poda	0.71	0.91	1.62	2000	1236	180	360000
	Vadagara	0.78	0.88	1.66	1829	1103	138	252402
	Total	0.78	0.88	1.66	1833	1106	139	254787
North West Zone								
	Karkachh	0.81	1.27	2.07	2757	1330	91	250887
	Vadagara	0.74	0.74	1.48	2433	1640	131	318723
	Total	0.80	1.22	2.02	2729	1349	94	256526
Total	Karkachh	0.71	1.10	1.81	2097	1158	106	222282
	Poda	0.57	0.81	1.38	1153	834	179	206387
	Vadagara	0.69	0.90	1.59	1535	966	142	217970
	Total	0.66	0.93	1.60	1593	998	142	226206

Notes Average quantity in MT and average price in Indian Rupees; figures in parentheses are percentages to the total sample

Source: Primary Survey

It is also observed that the average price of salt varies depending on the variety and quality (Table 3.5). The average value per salt pan in a season works out to about Rs 226206. The gross value obtained for Karkachh amounts to Rs 222282, while it is Rs 206387 and Rs 217970 for Poda and Vadagara. As mentioned earlier, these figures also suggest the promotion of Karkachh as a solution to maximising income.

3.7 Input output relations

A Cobb-Douglas production function has been fitted to examine the input output relations and also to estimate the returns to scale of salt production. The dependent variable of the production function is log of the total quantity of salt produced during 2011-12 season. The independent variables used in the production function have been chosen on the basis of our field level understanding of salt production process. The specified Cobb-Douglas production function is as follows.

$$LnYi=\beta 0+ \beta_1 LnX_{1j}+\beta_2 LnX_{2i}+?\beta_3 LnX_{3i}+\beta_4 LnX_{4i}+\beta 5LnX_{5i}+\beta_6 LnX_{6i}+\beta 7LnX_{7i}+ \beta 8\ LnX_{8i}+\beta 9LnX_{9i}+\beta 10LnX_{10i}+\beta 11LnX_{11i}+\mu i$$

We have considered labour, material costs and other factors influencing the production process such as the density of brine, number of wells etc on the explanatory side of the production function. Details of various inputs of salt production used on the explanatory side of the production function are provided in Table 3.6. These inputs are classified into labour and material inputs. Labour input is further classified into family labour and hired labour where family labour is expected to be the most important contributor to the production process, since the entire family gets involved in different stages of production. Moreover, in the traditional salt production process, the most important inputs are land area, family labour and crude oil pump for pumping out brine from deep wells. Land area is required for making condensers and crystallisers of the salt pan. The expenditure on crude oil (for pumping brine) constitutes a major share of the operational cost of salt production. In the production function, these three variables are represented by X1, X2, and X3. Variable X1represents the area used for making condensers and crystallisers for producing salt, while variable X2 stands for the number of human days spent on salt production by family members and variable X3 represents the cost of crude oil consumed for pumping out brine from wells. The basic characteristic of these variables is that they are essential inputs in the traditional salt production process. All these variables are expected to influence salt production positively. Since crude oil pump runs throughout day and night, the cost of crude oil accounts for a major share of the operational costs. The maintenance cost of crude oil pump and small equipments such as Dantala,Pawade has not been considered in the production function since it constitutes a small share of the total maintenance cost of production.It is also observed that Agariyas hire labour for certain activities. Hiring labour is occasional in salt production for completing certain labour works on time which is part of intensifying the traditional production process. As part of modifying the production technique, they use inputs like synthetic pipelines, dynamo etc to ensure a continuous brine supply to the condensers. In the production function, we have taken hired labour represented by X4 and a dummy variable represented by X5 to represent people's choice for synthetic pipelines instead of simple earthen channels to bring brine to the condensers. The advantage of using synthetic pipelines is that they do not lose the brine through percolation that happens in the case of earthen channels. Losing of brine also adds to the cost of crude oil because of a continuous pumping of brine to charge condensers.

As part of intensifying production and to address the issue of brine scarcity, Agariyas follow different strategies. The most important ones are increasing the number of wells in distant places from salt pans and deepening the existing wells. These variables represent the cost of addressing the scarcity of brine in the production process. Therefore, information related to additional wells is also assumed to be an important factor influencing the production of salt in the LRK. We have taken three variables in this respect viz. the number of total wells (X6); distance of wells from the condensers (X7); and depth of wells (X8). It is expected that going in for more number of wells in distant places may adversely affect production since it involves a higher cost and higher probability of losing brine if it is brought to condensers through earthen channels. Moreover, digging new wells and adding new equipments needs labour and money that can adversely affect production if these wells are not going to provide expected outputs. The deepening of the existing wells may help the production of salt if brine is available underground. Since these are activities fraught with uncertainties over the availability of brine, there is possibility of their influencing these variables negatively. Apart from these inputs, both quantity and quality of brine used for the production of salt are important that come from the ecosystem. There exist variations in brine quality across farms in different salt zones of the LRK. It is observed that the more the density, the less is the time for crystallisation. We have used a variable (X9) representing the brine density of each salt pan to understand whether the ecological characteristics of the LRK in terms of variations in the brine density affect the overall salt production. Another important variable that can influence the production of salt is producers' choice of the type of salt to be produced. People opting for Karkachh variety (X10) can harvest more than one yield in a season. A few of the Agariyas engaged in the production of Poda (X11) also extract more than one yield in a season, while the producers of Vadagara salt take only one yield in a season. To understand how the choice factor influences the production of output, we have used dummy variables for Karkachh and Poda varieties. It is expected that the choice of Karkachh or Poda might influence production positively as they can take more than one crop a season. In order to estimate the economic viability of traditional common salt production, net returns have been computed by taking the difference between the gross value of output and the total variable cost of salt production with and without imputed cost of family labour[5]. We also have calculated the ratio of gross value of output to the total variable cost to see the level of profit margin and to identify the farmers to examine whether salt production is viable and not viable for them.

[5]Imputed cost of labor is based on the opportunity cost of labor at current wage rate in the LRK

Table 3.6 : Estimated Production Function of Common Salt (Sodium Chloride)

Variables	Coefficients.	Std. Err.	t-value	P>|t|
(X1)Log of land used for condensers and crystallisers	0.360718	0.0972003	3.71	0.000
(X2)Log of Family labour days	0.03909	0.0225221	1.74	0.084
(X3)Log of crude oil quantity	0.109686	0.0563766	1.95	0.053
(X4)Log of hired labour days	0.0509088	0.0302297	1.68	0.094
(X5)Dummy variable for the use of synthetic pipelines	0.152225	0.064103	2.37	0.019
(X6)Log of number of wells	-0.1783991	0.0834531	-2.14	0.034
(X7)Log of distance of wells from condenser	-0.0228463	0.0203606	-1.12	0.263
(X8)Log of wells depth	0.1796714	0.0516154	3.48	0.001
(X9)Log of brine density	0.0243674	0.1630181	0.15	0.881
(X10)Dummy representing Karkachh	0.2194278	0.0830509	2.64	0.009
(X11)Dummy representing Poda	-0.00246	0.080636	-0.03	0.976
Constant	5.342597	0.5834249	9.16	0.000
Number of obs = 210				
F(11, 198) = 9.72				
Prob > F = 0.0000				
R-squared = 0.3507				

Source: Primary Survey

Table 3.7 : Comparison of cost and returns from traditional salt production

Type of Salt	Gross Value	Cost of Production (with imputed cost of family labour)	Ratio of gross value to total Cost (without family labour)	Cost of production (with family labour)	Ratio of gross value to total cost (without family labour)
Vadagara	217970	230486	0.95	168436	1.29
Poda	206387	252946	0.82	182591	1.13
Karkachh	222282	196178	1.13	121436	1.83
All	226206	228643	0.99	160711	1.41

Note: All values are in Rupees (current prices 2011-12)
Source: Primary Survey

As far as other material costs are concerned, crude oil constitutes a major component of the total cost. Adding more number of wells or deepening the existing wells for pumping additional quantity of brine adds only to the increased consumption of crude oil in the production process. It does not help address the issue of brine scarcity. Therefore, producers need to be educated with regard to rationalising certain costs so as to make production more cost efficient. The producers of Karkachh have the potential to achieve optimum returns, if a proper rationalisation of costs is affected. The aggregate cost can be minimised in various ways such as minimising wasteful charging of brine to condensers, adopting measures to stop percolation of brine, minimising the extra costs incurred on digging additional wells in distant places etc. Therefore, this study recommends an educational or a training programme for Agariyas towards minimising those activities that involve wasteful expenditures on salt production.

3.8 Quality of Output

Salt produced in the LRK is generally considered as low quality by traders and industrialists as it does not conform to the standards fixed by the Bureau of Indian Standards (BIS). As per the BIS norms, edible salt in dry conditions needs a minimum of 96 per cent of NaCl. The soluble impurities other than NaCl should not exceed the maximum limit of 3 percent and insoluble to a maximum of 1 per cent. The moisture content is fixed to a maximum level 6 percent. The iodine content of edible salt is fixed to be 31 ppm at the manufacturing end and 15 ppm at the consumers end. During the present study, we tested 16 salt samples from different locations in the LRK. Two of the samples were found below average quality and one (Sample No 1) nearer to edible quality as suggested by BIS. Of the sample, two were found nearer to industrial quality grade II (Sample No 9 and 14). All the remaining samples conformed to the 96 per cent level of NaCl. The sample of common salts collected from different zones in the LRK, except the South West zone, included Vadagara and Poda varieties. In the South West zone, the sample collected was Karkachh variety. An important reason for the presence of high impurities in Vadagara is mainly because of the inefficient management of brine.For example, regular charging of a low density brine to crystallisers and racking salt before forming salt beds causes the settling of impurities along with the crystallisation of NaCl. They keep brine in crystallisers at a height of 1 to 1.6 feet, while racking salt every alternative day. As a result, calcium impurities get deposited deeply inside the matrix of the Vadagara crystals. This process allows certain metals like manganese contained in brine to make Vadagara very hard and compact, while leaving virtually a little space for keeping the adhering bittern impurities in the matrix of crystals. It becomes practically impossible to reduce calcium content in Vadagara by a simple washing. This variety is mostly produced in the North East zone of the LRK and sold in the edible salt markets of central India. This type is used only for edible purposes since it contains high level of calcium and a low level of magnesium. This variety of salt with a high level of impurities is found difficult to iodise. In general, two sets of arguments exist in favour of and against the promotion of Vadagara variety salt and are summarised in Table 3.8. The promotion of Vadagara is still a contentious issue. Moreover, there is a high livelihood risk involved in a complete ban of Vadagara production.

Table 3.8: Arguments in favour of and against the promotion of Vadagara Variety of Salt

Arguments against the promotion of Vadagara	*Arguments in favour of Vadagara*
High level of impurities	Traditional variety of salt
Crystals are big, but surface area is less therefore iodisation is not successful	Support livelihoods of Agariyas in the LRK impurities with high Mg and CaIfound in Vadagara are good for human health
Low market price	
Not good for industrial use	
More land area is required for production	

Source: Based on Discussions with Salt Scientists and Agariyas

The second type of salt is Poda variety. It appears pure white in colour as there is half an inch of salt bed at the bottom for avoiding dust and other impurities. Another important characteristic of Poda production is that they discharge the bittern after every crop resulting in low impurities in the Poda variety. This is perhaps the best quality of salt generally produced in the South East and North East zones of the LRK (Table 3.9).

They usually break the crop into three or four and harvest medium size crystals. An advantage of uniform crystals is that it helps a uniform iodization. Those who produce Karkachh always prefer a proper saltpan layout and design for solar evaporation. Once the brine reaches the level of 24^0be' density, it is shifted to a pre crystalliser and kept till the brine reaches the level of 25^0 Be' density. Once it reaches the level of 25^o Be', it is directed into a crystallizer at a height of 4 to 6 inches. It is racked every alternative day to make the crystals slightly bigger. These crystals are found uniform and sparkling white in colour. They leave half inch of salt bed while harvesting and discharging of bittern after harvest makes Karkachh variety much better in quality for iodisation. This also suggests the importance of promoting Karkachh in the LRK for maximising salt quality and incomes.

3.9 Common Salt Markets

The local salt market the LRK has nearly 130 private traders. They are involved in salt trading and money lending to Agariyas. The traders have an informal understanding with producers regarding the lending rates of money and prices of different varieties of salt. They avoid competition among themselves. While lending money, they make

Table 3.9 : A Chemical Analysis of Common Salt from different locations of the Little Rann of Kutch

Sample No	Salt Zones	Ca	So4	Mg	Cl	CaSo4	MgSo4	MgCl2	Nalco	Moisture	Remarks	Location within Salt zone
1	South East	0.180	0.950	0.880	59.360	0.611	0.649	2.936	94.280	1.524	Grace edible	Halvat
2	South East	0.170	1.520	1.240	58.840	0.577	1.392	3.764	92.406	1.862	Substandard	Halvat
3	South East	0.270	0.650	0.290	60.000	0.916	0.005	1.131	97.551	0.396	Edible	Halvat
4	South East	0.390	1.160	0.620	59.300	1.323	0.284	2.204	95.079	1.109	Edible	Kharaguda
5	South East	0.850	2.100	0.310	58.700	2.883	0.084	1.148	95.387	0.498	Grace edible	Kharaguda
6	South East	0.340	0.820	0.350	59.750	1.153	0.008	1.363	96.854	0.621	Edible	Dragadra
7	North East	0.270	0.650	0.230	60.000	0.916	0.005	0.896	97.840	0.343	Edible	Santalpur
8	North East	0.330	0.800	0.340	59.700	1.119	0.013	1.320	96.824	0.723	Edible	Santalpur
9	North East	0.210	0.510	0.280	60.000	0.712	0.010	1.088	97.604	0.586	Grace industrial grade II	Santalpur
10	North East	0.460	1.240	0.780	59.100	1.560	0.175	2.916	93.876	1.473	Substandard	Santalpur
11	North East	0.430	1.030	0.500	59.400	1.459	0.002	1.956	95.550	1.034	Edible	Santalpur
12	North West	0.190	0.460	0.350	60.100	0.644	0.007	1.364	97.430	0.554	Edible	Adeser
13	North West	0.270	0.750	1.400	59.100	0.916	0.130	5.378	90.854	2.723	Substandard	Adeser
14	North West	0.260	0.630	0.220	60.000	0.882	0.010	0.853	97.893	0.362	Grace industrial grade II	Adeser
15	North West	0.260	0.630	0.400	59.850	0.882	0.010	1.558	96.780	0.770	Edible	Adeser
16	South West	0.460	1.110	0.440	59.430	1.560	0.012	1.713	95.897	0.817	Edible	Malya

Source : Based on Laboratory tests

agreement with Agariyas that salt will not be sold to other parties. Lending money and purchase of salt is done on a reciprocal basis. The money lenders of Agariyas are also found to be group lenders in many locations of the LRK, so that traders can distribute the risk of getting back money from the loss making to profit making Agariyas. Advance lending and procurement of salt at low prices leaves Agariyas with no reasonable profit margin. As a result, they remain in a debt trap throughout the year and sometimes it is carried forward into the next year. The salt market is highly imperfect and acts as a powerful lobby in the LRK.The traders also add value to salt before it is transferred to the final destination. They employ labourers and hire trucks for transporting salt from the LRK to the storage place. It is stored in rented go downs belonging to salt cooperative societies. Labourers are employed for making stacks of salt for iodisation. The iodisation is done for both ground and crystal salts depending on the market requirements. Traders also work as commission agents for companies by charging 8 rupees as a margin per tonne of salt. There are two ways to sell salt to companies. The trader either sends the processed salt with labels of a local company to the storage place or the company concerned transports salt bags to the wholesale trader and then to retail traders. The company prices of Vadagara, Poda and Karkachh ranged from Rs 900 to 1000 in 2011 in the domestic market. The final price of salt includes tax, selling and storage costs. However, the company concerned has to bear all other fixed costs. Salt reaches the dealer at a price of approximately Rs 7400. The final consumer pays a price higher than this depending on the quality and distance of transportation. In a study on value chain of LRK salt market, it is noted that a higher percentage of its value goes to companies and middlemen (Sukla, 2012). The market, through collusion of local traders, keeps the farm gate price of salt at a low level affecting the livelihoods of Agariyas besides leaving them with no surplus or sometimes even with loss.

3.10 Production and Market Risks

An earlier study gives an account of various risks involved in the production of salt in the LRK (Bharwada and Mahajan, 2008). Among the natural risks, the most important ones are unexpected rains, declining brine, fatal gases released from wells and high velocity winds. The declining brine and high velocity winds during summer force Agariyas into winding up all production activities. The dust coming with high velocity winds makes their product impure with lots of insoluble which in turn, finally lead to a low price. The decreasing availability of brine in wells also makes them uncertain of generating an expected output, particularly in the case of those who go in for a second crop of Poda. To avoid the risk of impurities from dust, they incur an additional cost on making bunds around condensers and crystallisers or stop production activities in the early summer itself. If they come to know the likelihood of a declining output, they opt for a contract with the trader for producing the second crop of Poda salt so that the risk can be shared with the trader. But the contract is always in favour of the trader. However this risk sharing mechanism is not necessarily a way out for a majority of Agariyas, since traders always look for an opportunity to exploit the desperate situation of Agariyas at the end of the season. A desperate situation is created not only by natural risks in salt production, but also market imperfections engineered by traders. A tacit understanding between traders and truck owners in terms of delaying the pickup of salt from salt pans creates panic among the farmers towards the end of the season. Finally, Agariyas will sell the product at throw away prices to the local traders, there by foregoing their profit margin. As we have noted earlier, the debt trap created by traders through advance lending also helps them keep the farm gate price of salt at a lower level. Agariyas are vulnerable to both natural and market risks that act as a downward pushing factor with respect to income, resulting in a livelihood security. Therefore, addressing natural and market risks through institutional mechanisms is a primary condition for providing secure livelihoods to Agariyas. Since the local traders are very strong and united, it is not easy to reform salt market through government policy changes, but collective efforts of Agariyas can improve their bargaining capacity. Therefore, this study recommends collective efforts on the part of Agariyas to improve their bargaining capacity by pooling various types of risks and developing new marketing strategies. It is also important to promote the production of by-products (non-common salts) to supplement the current levels of income. In the next section, we discuss the possibilities of extracting non-common salts from the bittern.

3.11 Summary and Conclusion

An earlier chapter reveals that poverty is high among salt pan workers along with various livelihood threats from market and nonmarket forces. It identifies livelihood risks such as unexpected rains, declining brine yields, fatal gases from wells and high velocity winds during the course of salt production, price volatility and risk of eviction from the salt zones for biodiversity conservation. A techno-economic analysis that we have carried out in this chapter shows traditional system of salt production is a highly labour intensive activity with a high proportion of family labour, and the use of traditional equipments and techniques. The main natural resource for salt production happens to be subsoil brine. A laboratory test on the quality of subsoil brine shows a high concentration of salt at 17° Be, an important advantage for production in terms of saving time and labour for solar evaporation. The disadvantage is deficiency of sulphate in the brine. The presence of sulphate is important to achieve a rapid production of a high quality sodium chloride. Sometimes Calcium Sulphate crystallises simultaneously with sodium chloride, adding impurities to it. This is one of the crucial issues needing to be addressed for improving the quality of NaCl. Different lab tests have already proved the presence of high impurities in this variety as compared to Karkachh and Poda varieties. Therefore, the promotion of Karkachh has been suggested as a solution to improving salt quality and thereby livelihoods of the people. The cost of materials, fuel and labour constitutes the total cost of production. The total operational and maintenance cost accounts for around 62 per cent of the total cost of production. The remaining cost is distributed among family and hired labour. The consumption of fixed capital other than crude oil pump in salt production is negligibly low. The distribution of cost across materials and labour shows that crude oil cost for pumping subsoil brine takes a major share followed by family labour,indicating that the cost minimisation strategies in salt production should focus on saving crude oil consumption. The promotion of energy saving methods of production and the use of alternative sources of energy can help them reduce the overall cost of production. The average production of salt in the LRK amounts to 1593 tonnes per salt pan. The yield of Karkachh averages 1158 tonnes in a year, while it is 834 and 966 tonnes for Poda and Vadagara. Vadagara is considered as one of the cheapest quality salts, since it is bigger in size and difficult to iodize though most of the Agariyas prefer to produce Vadagara. The price per tonne of Vadagara variety is low compared to Poda variety. The quantity of Karkachh produced per farm is also higher than Poda variety, but the price fetched per tonne is relatively lower. The price per tonne of Karkachh variety amounts to Rs 106 per tonne, while it is Rs 142 for Vadagara and Rs 179 for Poda. A lower price for Karkachh observed in the North Western side (Adeser) is due to high transportation costs. It is also observed that the average price of salt varies depending on the variety and quality. The average value per salt pan in a season amounts to about Rs 226206. The gross value obtained for Karkachh works out to Rs 222282 Rs 206387 and Rs 217970 for Poda and Vadagara respectively. As we mentioned earlier, these figures also suggest the promotion of Karkachh as a solution to maximising income.A Cobb-Douglas production function has been fitted to examine the input-output relations and to estimate the returns to scale of salt production. It shows that adding more number of wells or deepening the existing wells for pumping additional quantity of brine only adds to an increased consumption of crude oil in the production process and that it does not help address the issue of brine scarcity. Therefore, producers need to be educated towards rationalising certain costs so as to make the production process more cost efficient. The producers of Karkachh have the potential to realize optimum returns, if a proper cost rationalisation is affected. The aggregate cost can be minimised through various ways such as minimising wasteful charging of brine to condensers, adopting measures to stop percolation of brine, minimising extra costs on additional wells in distant places etc. Therefore, this study recommends an educational or a training programme for Agariyas towards minimising activities that generate wasteful expenditures during salt production. The salt produced in the LRK is generally considered as of low quality by traders and industrialists, since it does not conform to the standards fixed by the Bureau of Indian Standards (BIS). Samples of salt tested show abelow average quality in many cases. An important reason for the pressure of high levels of impurities in Vadagara is mainly an inefficient management of brine. For example, a regular charging of a low density brine to the crystallisers and racking of salt before forming salt beds can help impurities settle along with the crystallisation of NaCl. They keep the brine in crystallisers at a height of 1 to 1.6 feet and do racking of salt every alternative day. As a result, calcium impurities get deposited deeply inside the matrix of the Vadagara crystals. This process allows certain metals like manganese contained in the brine to make Vadagara very hard and compact, leaving virtually a little space for keeping the adhering bittern impurities in the matrix of the crystals. It becomes practically impossible to reduce calcium content in Vadagara by a simple washing. This variety of salt with a high level of impurities is found difficult to iodise. In general, two sets of arguments exist in favour of and against the promotion of Vadagara salt. The promotion of Vadagara is still a contentious issue. Moreover, there is a high livelihood risk involved in a total ban on Vadagara production. The local salt market in the LRK has nearly 130 private traders involved in salt trading and money lending to Agariyas. The traders have an informal understanding with producers regarding lending rates and prices of different varieties of salt. The salt market is highly imperfect and acts as a powerful lobby in the LRK. The traders also add value to salt before it is transported to the final destination. The market imperfections, through local traders' collision keep the farm gate price of salt at a low level, affecting the livelihoods of Agariyas besides leaving them with no surplus or sometimes even with a loss. Agariyas are vulnerable to both natural and market risks that act as a downward pushing factor with respect to income, resulting in a livelihood insecurity. Therefore, addressing natural and market risks through institutional mechanisms is a primary condition for providing a secure livelihood for Agariyas. Considering that the local traders are very strong and united, it is not easy to reform the salt market through government policy changes, but collective efforts on the part of Agariyas can improve their bargaining capacity. Therefore, this study recommends collective efforts on the part of Agariyas to improve their bargaining capacity by pooling various types of risks and developing new marketing strategies. This can be achived with assistance from government or non government organisations developing microlevel planning and stratagies.

Chapter-IV

Non Common Salt Production

4.1. Introduction

The previous chapter showed that improving quality of common salt is necessary for augmenting the livelihoods of Agariyas and also that it is important to develop institutional mechanisms to counter the strong lobby of local traders and agents which, in turn might help Agariyas secure their livelihoods by pooling various types of risks involved in salt production and the market. In addition, exploring technical solution for extracting non-common salts from the mother liquor after the production of sodium chloride provides for further strengthening of livelihood security through additional incomes. Therefore, this chapter address two questions pertaining to the extraction of non-common salts. First, whether non-common salt is important from a livelihoods point of view. Second, whether it is possible to recover non-common salts at the farm level to strengthen livelihoods? Getting right answers to these questions give directions to formulating strategies to improve Agariyas' livelihoods.

4.2 By-Products from Salt Production

In order to answer the first question, we look at the secondary information related to the salt by-products such as calcium sulphate and magnesium chloride in detail. The Salt Commission reports that calcium sulphate , magnesium chloride, magnesium sulphate, bromine, alkaline bromide and crude salt are the important by-products or non-common salts that can be produced from the mother liquor at different stages of brine evaporation. These chemicals are generally produced by industrial units using the mother liquor after the recovery of sodium chloride. Data from the salt commission shows that calcium sulphate (Marine gypsum) is recovered from salt pans during the production process of common salt in coastal regions, particularly Gujarat and Tamil Nadu. It is mainly used for industrial purposes, especially cement industrial units and also for the production of plaster of paris, plaster bandages, toys, statues, white cement etc. The trends in the

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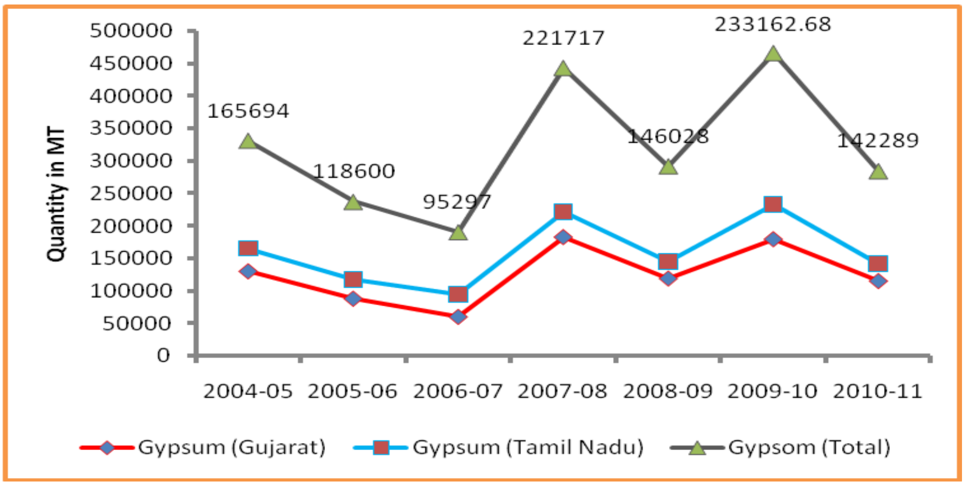
[6] Calcium sulphate or gypsum that occurs in nature is called mineral gypsum. In addition to mineral gypsum, seawater brine or subsoil brine is a source of marine gypsum.

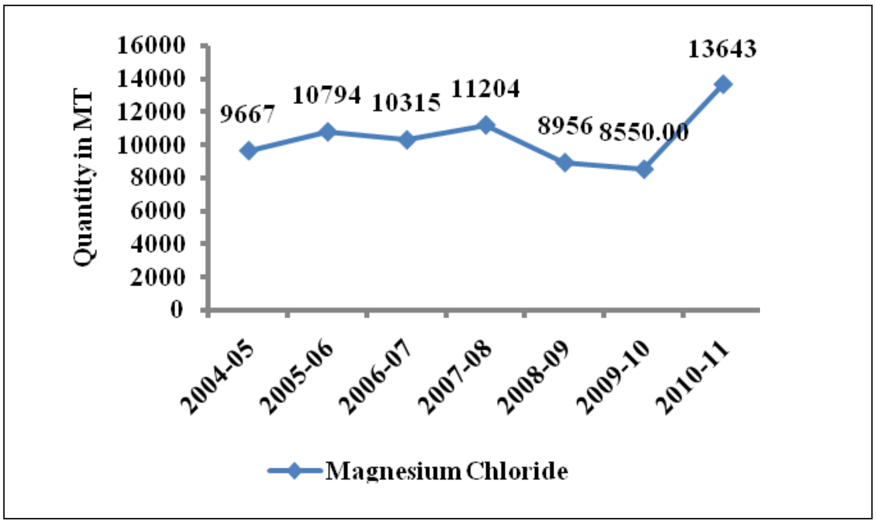
production of marine gypsum increased from 165,694 tonnes in 2004-05 to 233,162 tonnes in 2009-10 although 2010-2011 data show a declining trend i.e., 142,289 tonnes (Figure 1). The price of gypsum also doubled during the last five years, from Rs 348 per tonne in 2004-05 to an average of 610 in 2010-11 (Figure 4.1).A high price and diversified use of gypsum makes this chemical economically more attractive to the producers in coastal areas.

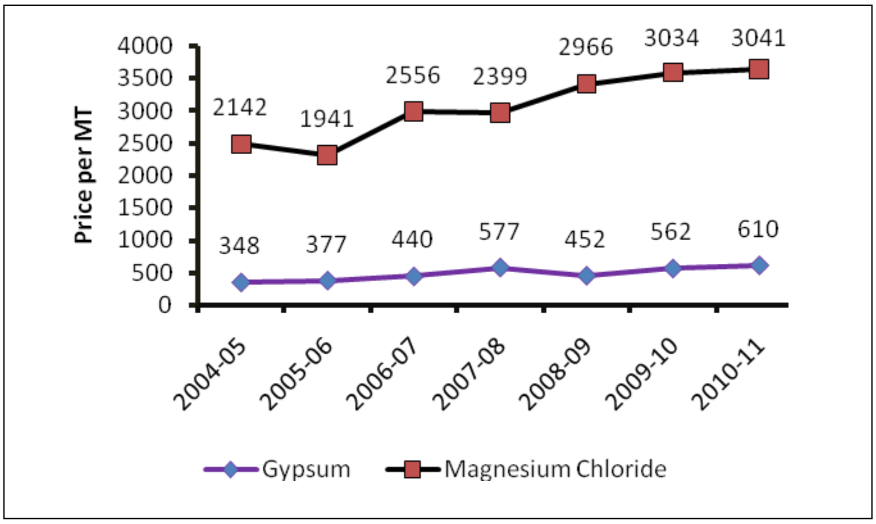
Figure 4.1 : Production trends of Gypsum from common salt production in Gujarat, Tamil Nadu and India



Another important by-product is magnesium chloride. The crystalline magnesium chloride, if produced scientifically, has a better application quality for the recovery of magnesium metal, or can be utilized for producing magnesium compound viz. Light and Heavy basic $MgCO_3$, magnesium silicate, tri-silicate, Mg (OH) 2, or manufacture of MgO, which can be utilized for the manufacture of fire bricks. Magnesium chloride can be utilized for the manufacture of Amri stone and special grade of tiles. Although the production of magnesium chloride went up by 59 per cent during 2010-2011, it stagnated over a period from 2004 to 2009.The average price of magnesium chloride in 2010-11 was Rs3041 per tonne (Figure 4.2),an increase of 18 per cent as compared to 2004-05 (Figure 4.2).The analysis shows a positive trend in prices and quantities of magnesium chloride and gypsum, which in fact indicates that there is a sufficient scope for promoting technologies among Agariyas so as to help them earn supplementary incomes and livelihoods by extracting these chemicals. In this context, the basic question is whether it can be extracted at the farm level without creating any externalities to biodiversity conservation of the area though it is very significant from a livelihoods point of view.

Figure 4.2 : Trends in production and prices of Magnesium Chloride and Gypsum during 2004 to 2011





4.3 Farm level Production of Non Common Salts

The recovery of non-common salts needs special skills and knowledge. At present a few Agariyas are involved in the production of non-common salts, using the simple solar evaporation technique at the farm level. Farm level production means the production of non-common salts such as calcium sulphate and magnesium chloride from the mother liquor after the production of common salt at the farm level using the traditional method of solar evaporation. This does not amount to any sort of intensification of salt production at the farm level, using machineries or boilers. An improvement in this method using better brine and time management might help Agariyas earn additional incomes. Brine examination and discussions with salt scientists reveal that different non-common salts present in the LRK can be extracted at the farm level for livelihood improvement[7]. Details regarding extractable salts at the farm level before and after the recovery of common salt based on laboratory experiments tests of brine are provided in Table 4.1. The Table also provides a picture of various issues related to the current extraction of these salts at the farm level. An important challenge with respect to the improving livelihoods of Agariyas is to overcome these issues. The technological and economic solutions to overcome these challenges are presented in section II of this chapter. The success stories of extracting non-common salts under joint experiments of CSMCRI and Agariya Heet Rakshak Manch with support from the Commissioner of industries, Government of Gujarat, are also discussed in section II. In the next sub section, we discuss the techno-economic aspects of traditional common salt (NaCl) production and the risks involved in it.

Table 4.1 : Recoverable Non-Common Salts at the farm level in the LRK for improving Livelihoods

Recoverable Salts of LRK	*Issues at the Farm level*
Calcium Sulphate ($CaSO_4$ 2H2O)	No Agariya is Interested in extracting Calcium Sulphate since it commands a very low price in the market. The market for this product is found to be undeveloped in the LRK The opportunity cost of extracting this product is also found to be higher. They prefer to spend the available time for NaCl production.
Crude Salt	It is a waste salt after the recovery of NaCL. It comes to almost 6 percent of the total production. Since it is formed at the end of the season, they do not spend time on recovering NaCl from crude salt. It is possible to recover this even with a rain wash.
Carnalite (KCL, MgCl2, NaCL)	KCL can be extracted (it is also called Murate of Potash MoP). This can be used for producing low sodium salt that has a good market.
Magnesium Chloride (Mg CL2)	A Few Agariyas are extracting MgCL2 but with high impurities.

Source: based on laboratory tests on Brine samples

[7]Some of the past experiments of CSMCRI shows that extraction of certain chemicals might not be possible at the farm level, because it is capital-intensive and needs the application of modern technology which is beyond the capacity of Agariyas (Refer Table - 1.2 in Chapter I)

Sodium chloride crystallises when the brine reaches 23° Be density through solar evaporation. Generally, the brine after the crystallisation (locally called bittern) of sodium chloride is thrown to the desert or sold to a local trader at a throw away price of Rs 100 per tanker lorry. Only 8 farmers have reported that they sell bittern to local traders. We have estimated that, on an average, they make an income of Rs 2800 through sale of bittern. Since bittern is considered a value less product, many salt pan workers just throw away this waste.

At present, the production of gypsum in LRK is negligibly low though there is an immense scope for extracting this chemical. As we have seen earlier, one reason is the presence of an insufficient sulphate in subsoil brine required for the formation of calcium sulphate. Finding a solution by way of adding sulphate to brine might be an uneconomic activity from a livelihoods point of view. Therefore, the scope for developing a technique by adding sulphate is completely ruled out in the context of livelihoods. Secondly, no Agariya is interested in extracting this chemical, since it fetches a very low price in the market, even asthe market for this product is found to be undeveloped in the LRK.

Calcium sulphate ($CaSO_4$ 2H2O) or gypsum is also found in the brine of the LRK.Gypsum settles down to around 17^{O} Be of the Brine before common salt starts settling. But Agariyas are not very keen on producing gypsum due to various reasons. It is reported that the farm gate price of gypsum is very low in the LRK. In addition to the low price, we find that the opportunity cost of labour in terms of extracting gypsum is relatively higher. Also, labour scarcity among migrant labourers is as an important constraint to the production of gypsum as they give preference to activities related to the production of common salt. A high opportunity cost of labour and a relatively low price for gypsum act as a disincentive for Agariyas to extract gypsum. It is technically and economically a big challenge to remove gypsum from brine. But economic and technical solutions to the removal of gypsum can immensely help Agariyas earn extra income by improving the quality of common salt. The study has identified that the Agariyas are unaware of the advantages of removing gypsum before the recovery of common salt. At present, the percentage of gypsum in common salt remains at a higher level in the form of impurity, affecting its quality. The removal of gypsum can improve the quality of common salt besides fetching a higher price in the open market. Therefore, this study recommends a further scientific enquiry for removing gypsum at the farm level through simple and environment-friendly technologies.

However a minor change in the quality of common salt by way of removing gypsum would not make any difference to the price due to market imperfections and the role of middleman. Aprice change can happen only when the quality of common salt improve to the industrial grade. As long as the farm gate price of common salt is independent of quality due to high imperfections and middle man roles, and it remains at as low as 15 per kg, Agariyas may not show much interest in removing gypsum from salt pans. Any technical solution towards removing gypsum should be accompanied by market reforms. Any intervention in the extraction of gypsum should consider two aspects of its production and marketing: (a) Agariyas' 'ignorance about the scientific advantages of gypsum recovery for improving the quality of NaCl; and (b) gypsum recovery must be linked to a programme for improving the quality of sodium chloride to the industrial grade so that they get better high market benefits.

Another product is crude salt; it is a waste salt after the recovery of common salt. It amounts to almost 6 percent of the total production. Since it is formed at the end of the season, they do not spend time on there covery of NaCl from crude salt. It is possible to recover this even with a rain wash. It is also possible to extract Carnalite (KCL, $MgCl_2$, NaCL) (it is also called Murate of Potash MoP) from crude salt. Adverse climate conditions and a high opportunity cost of labour due to loading and unloading activities of common salt simply prompt people to throw way crude salt. This can be used for producing low sodium salt that has a good market. In the present context, all these chemicals are wasted in the LRK. As far as Magnesium Chloride ($Mg CL_2$) is concerned, a few Agariyas are extracting it, but it has high levels of impurities. It is locally called 'Suya' from the bittern. The sample data shows that nearly 10 per cent of the Agariyas produce Suya (Table 4.2). Most of the Suya producers are in the South Eastern Zone of the LRK, while a few of them are in the South West zone. There is one case of Suya production reported from the North eastern zone. No one in the North West Zone is engaged in Suya production. In the beginning of the season (September- October), Suya is produced from the bittern kept in a pond at the end of the previous season, a supplementary sources of income for some Agariyas.It is estimated that Agariyas receive, on an average, Rs 18190 from magnesium chloride.

Table 4.2 Value of Suya Produced from Bittern

Salt Zones	Net]Value from Magnesium Chloride (Suya)	Quantity of Bittern Sold	Net Value of Bittern
South zone	18285 (14)	28 (8)	2800 (8)
South west zone	18000 (6)		
North zone	18000 (1)		
Total	18190 (21)	28 (8)	2800 (8

Figures in parentheses are the number of reported cases

Source: Primary Survey

The current attempts by a few Agariyas in terms of producing non-common salt shows the feasibility of its production at the farm level. Further, development of brine management by way of including scientific knowledge to their techniques at the farm level can bring about a significant change in the livelihood prospects of salt pan workers.

4.4 Scientific Interventions: A Success Story

The Central Salt and Marine Chemical Research Institute conducted various experiments with respect to non-common salt production in the coastal areas of Rajuala. The Agariya Heet Rakshak Munch is a collaborator in these experiments with financial support from the Government of Gujarat. It aimed to upgrade the salt production methodology for producing good quality salt on par with an industrial grade with a simultaneous recovery of gypsum. Secondly, the programme aimed recovery of other marine chemicals from the waste bittern. Finally, the programme attempted, by way of establishing a quality control lab to ensure that the technology was applied at the grass root level so as to help producers gain tangible benefits. As part of implementing the programme, it was planned to form a cluster of 150 salt workers at Rajula. Training programmes were planned to impart scientific techniques to Agariyas for producing better quality salt with an assured increase in yield levels. The programme adopted certain salt units for conversion to demonstration units. The approach of the experiments are given in Tables 4.3 and 4.4.

Table 4.3 : Approach of the AHRM-CSMCRI Experiment at Rajula in Amreli District for improving the quality of NaCl

A comprehensive survey of Agariyas at Rajula for assessing their capabilities to adopt scientific methods for salt production.
Cluster formation and selection of Agariyas based on the availability of brine
Classification of Agariyas into cluster-wise groups and conducting indoor training courses
Field exposure training to Agariyas regarding scientific production
Design and layout of model salt pans
Harvesting of salt in all the salt works taken up under the project for quality up gradation.
Chemical characterization of salt and assessing its quality for industrial use.
Testing of salt by user industrial units.
Marketing of salt to user industrial units.

Source: CSMCRI-AHRM 2011

Table 4.4 : Approach of the AHRM-CSMCRI Experiment at Rajula in Amreli District for extraction of non-common salts

Laying out additional pans for the evaporation of bittern for the production of value added bittern based product.
Pilot testing of the pertinent technology for salt up gradation in the context of Rajula brine and Agariya practices.
Evaporation of bittern for recovery of salt mixtures enriched with potassium and magnesium. (CSMCRI)

Source: CSMCRI-AHRM 2011

This experiment resulted in the production of industrial quality NaCl and other non-common salts. The results of the experiments are provided in Table 4.5.

Table 4.5 : Recovery of various chemicals from the CSMCRI-AHRM experiments at Rajula

Constituents	Before washing (% w/w)	After washing (% w/w)	Rain-washed salt from one of the marginal salt works Date of collection: 29/09/2011
Ca	0.16	0.09	0.028
Mg	0.32	0.06	0.04
SO4	0.72	0.35	0.14
NaCl	98.3	> 99	99.66
(on dry basis) Insoluble	0.50	0.20	0.15
Moisture	5.00	< 1	<1

Source: Source CSMCRI-AHRM 2011

The field level experiments (using sea brine) also show a successful recovery of Potash sulphate from the bittern. Potash sulphate is a highly valued commodity in India, a net importer of potash. The recovery of potash from bittern is the cheapest and easily available source for the fertilizer industry in India. This experiment suggests a high possibility of introducing similar programmes in the LRK with co-operation from AHRM.

4.5 Conclusion

In continuation of our analysis in chapter III of improving the quality of common salt as a means of improving livelihoods, this chapter highlights the significance of extracting non-common salts as an additional source of income. Non common salts or by-products cover a range of chemicals -calcium sulphate, magnesium chloride, magnesium sulphate, bromine, alkaline bromide and crude salt. It is produced from the mother liquor at different stages of the brine evaporation process. A relatively high price and diversified use of these products make its production economically more attractive. This indicates a scope for promoting technologies among the Agariyas for earning supplementary income by extracting a few of these chemicals at the farm level. The recovery of non-common salts needs special skills and knowledge. At present, a few Agariyas are involved in the production of non-common salts, using the simple solar evaporation method at the farm level. An improvement in this method using better brine and time management can help Agariyas earn additional income.At present, the production of gypsum in the LRK is negligibly low though there is an immense scope for extracting this chemical despite technological challenges due to an insufficient sulphate presence in subsoil brine. At present, no Agariya is interested in extracting this chemical since it involves a very high opportunity cost of time. A high opportunity cost of labour and a low price of gypsum act as a disincentive for Agariyas to extract gypsum. But the removal of gypsum can improve the quality of common salt besides fetching a high price in the open market. Therefore, this study recommends a further scientific enquiry for removing gypsum at the farm level through simple and environment-friendly technologies. Any intervention in the extraction of gypsum should also consider its production and marketing aspects: (a) Agariyas ignorance about the scientific advantages of gypsum recovery for improving the quality of NaCl; and (b) gypsum recovery must be linked to a programme for improving the quality of sodium chloride on par with the industrial grade so that they get high market benefits. Another product is crude salt, a waste by-product of common salt. It amounts to almost 6 percent of the total production. Since it is formed at the end of the season, they do not spend time on there covery of NaCl from the crude salt. It is also possible to extract Carnalite (KCL, MgCl2, NaCL, also called Murate of Potash MoP) from crude salt. Adverse climate conditions and a high opportunity cost of labour due to loading and unloading activities of common salt simply prompt people to throw away these chemicals. This can be used for producing low sodium salt that has a good market. As far as Magnesium Chloride ($Mg\ CL_2$) is concerned, a few Agariyas are extracting it, but it contains high levels of impurities. This is a supplementary income for some Agariyas. It is estimated that Agariyas receive, on an average, Rs 18190 from magnesium chloride. The current attempts by a few Agariyas in terms of producing non-common salts shows the feasibility of its production at the farm level. A further development of brine management by including scientific knowledge to their techniques at the farm level can bring about a significant change in the livelihood prospects of salt pan workers. The success story of Rajuala experiment by the CSMCRI and AHRM substantiates the possibility of the same type of experiments in the LRK. This experiment resulted in the industrial quality NaCl and other non-common salts. While promoting these products, an important question that arises is how it affects the conservation of biodiversity, particularly the wild ass population. In the next chapter we, discuss some of the important issues pertaining to salt production and wild ass conservation.

Chapter-V

Salt Production and Biodiversity Conservation

5.1. Introduction

The term biological diversity or biodiversity expresses the variety and variability of life forms existing in an area, viz. genetic, species and ecological diversities and its conservation is a part of the larger objective of sustainable development. The LRK is characterised by a unique ecosystem with saline deserts and wetlands across different seasons with a high biodiversity value. The LRK ecosystem provides various direct and indirect services to the human society in addition to habitats for the Wild Ass and other wild animals. This ecosystem was notified as a wildlife sanctuary in 1973 and was selected for conservation as a Biosphere Reserve by the Government of India. The Indian wild Ass (*EquushemionusKhur*), a species endemic to India, is the main attraction of the area. The LRK ecosystem supports the livelihoods of the people through agriculture, animal husbandry, fishing, traditional salt production and charcoal making. The traditional inland salt production using subsoil brine available in the LRK by the migrant salt workers (Agariyas) is one of the most significant livelihood activities in this area. We have already noted that approximately 12 to 15 thousand families of Agariyas, including children migrate from nearby villages bordering the LRK for producing salt during September - May every year and contribute almost 40 per cent of the total salt produced in Gujarat. Despite the importance of inland salt production, the life and livelihoods of the salt workers continue to face miserable conditions. This is due to both price and non-price factors. They also face a possible eviction from the LRK due to the notification of the Wild Ass Sanctuary. In short, there seems to be existing a conflict between conservation objectives and local livelihoods particularly in the case of salt production workers. An important question at the policy level is whether salt production creates any external cost to the conservation of wild ass species. The external cost of salt production is the cost of disturbances created by salt producers to the existence of wildlife. What are the important externalities of salt production that lead to habitat and biodiversity loss/ disturbance? Stated otherwise, it is important to ask whether salt production is intruding into the space of wild animals. Or is there a co-existence? What is the attitude of

Agariyas towards conservation of wild ass? What are the important governance challenges of biodiversity conservation vis-a-vis salt production in the LRK? How can all such challenges addressed?

5.2 Salt Production Related Externalities

Two important sources of salt production related externalities within the sanctuary are :(a) Expanding salt production can push wildlife out of the sanctuary area; (b) Movements of trucks for lifting salt from the LRK cause disturbances to the wildlife. There are official and peoples' versions of the argument with respect to these externalities (Table 5.1). The official version is that salt production, being an expanding activity, has a negative impact on wildlife, while on the other side, it is treated by people as a traditional activity confined to a few locations within the LRK. Since there exist wide variations in the density and availability of brine, Agariyas tend to generally stick to one location for salt production. Changing locations within a short time span of 8 moths can be highly expensive and non affordable to them. There is no guarantee that a new location can provide a good quality brine. This study also has observed that movements of Wild Ass in Salt Zones for food or water is a very rare phenomenon, since no water or vegetation is present in these areas. The expansion of salt zones through expanding of salt production activities is negligibly low in the LRK and therefore, there are no tangible negative impacts in terms special conflicts between salt production activity and wild Ass conservation.

Table 5.1 : Arguments with respect to the salt production externalities

Official perspective	Agariyas perspective
Salt production is expanding with a negative impact on habitats.	Salt production activity is confined to a few non-expanding locations only.
Human intervention through salt production keeps animals away from salt zones.	There is no water or vegetation in salt zones, therefore, animals move away in search of food and water to agricultural farms.
Agariyas not sticking to one place for salt production affects wildlife.	Generally stick to one location since there is no guarantee that a new location has a good brine presence.
Truck movements affect wildlife existence.	Most of the Agariyas produce traditional types of crystal salt harvested once in a year (summer). Therefore, there is no uniform frequency of truck movements throughout the season.
Agariyas collect fuel wood, Prosopisjuli flora plants,from the LRK fringe areas.	

Based on discussions with forest officials and FGDs with Agariyas

The second issue-the movements of trucks for lifting of salt from the LRK-cause disturbance to wildlife. However since most of the Agariyas still prefer to produce traditional varieties like *Vadagara and Poda,* the frequency of truck movement is not uniform throughout the season. These verities are lifted once in a season from salt pans. Therefore, truck movements for lifting of salt start only in summer, particularly from March to May. This is the time when most of the animals are out of salt zones as they turn into a virtual desert. There is no water or food available in the salt producing areas during summer. But an intensification of these activities as a livelihood strategy, through promoting *Karkachh verities* of salt, can lead to a more uniform truck movements which can adversely affect wildlife conservation. Therefore, it is important to devise livelihood strategies, while taking into account traditional salt verities, which are more conservation-friendly. All the same, the present system is found to be more traditional and friendly towards wildlife management.

5.3 Agariyas attitude towards Conservation

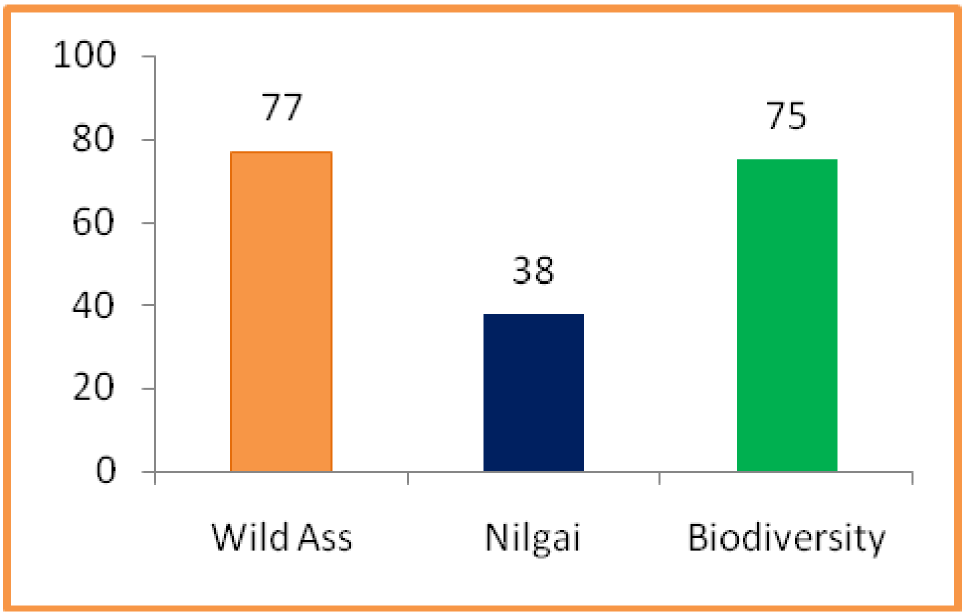
The elicitation of environmental preferences is found to be very important to arrive at conclusions regarding how an individual values conservation efforts. In this survey, the preference elicitation was done to know the respondent's preference towards biodiversity conservation in general and of wild ass and Nilgai in particular. Several questions were posed to elicit the Agariyas 'preferences towards biodiversity conservation. Most of these were in the form of statements. An example has been given in Table 5.2.

Table 5.2 : Preference Elicitation for Wild Ass Conservation

1. Do you feel it is important to conserve Biodiversity? Yes = 1 No = 2
2. Do you feel it is important to conserve Wild Ass? Yes = 1 No = 2
3. Do you feel it is important to conserve Nilgai? Yes = 1 No = 2
CONSERVATION OF WILD ASS IS IMPORTANT BECAUSE
(I shall explain certain benefits from Wild Ass conservation and you please rank it according to your preference)
4.Wild Ass is a beautiful animal, can create an opportunity for recreation
5. Wild Ass has its own right to exist
6. Wild Ass has educational value
7. Wild Ass may be useful for certain domestic work in future
8. We may find new uses for Wild Ass in the future
9. Any other (specify)

The first three questions were general; some specific questions (4 to 9) were posed to the respondents to elicit the reasons why they think wild ass conservation in LRK was important. It is evident that most of the respondents consider biodiversity conservation as important in the LRK (Figure 5.1). About 75 percentage of the respondents think biodiversity conservation is important. Out of the 210 respondents, around 77 per cent are in favour of wild ass conservation. Nearly 55 per cent of those who like wild ass attribute their liking to the beauty of the animal and believe that the animal has its own right to exist. Those who feel 'the conservation of wild ass is not important', attribute their reason to livelihood concerns. Nearly 26 percent of the Agariyas opine that conservation of wild ass is a threat to their livelihood sources.

Figure 5.1 : Agariyas' Preference for conservation of Wild life

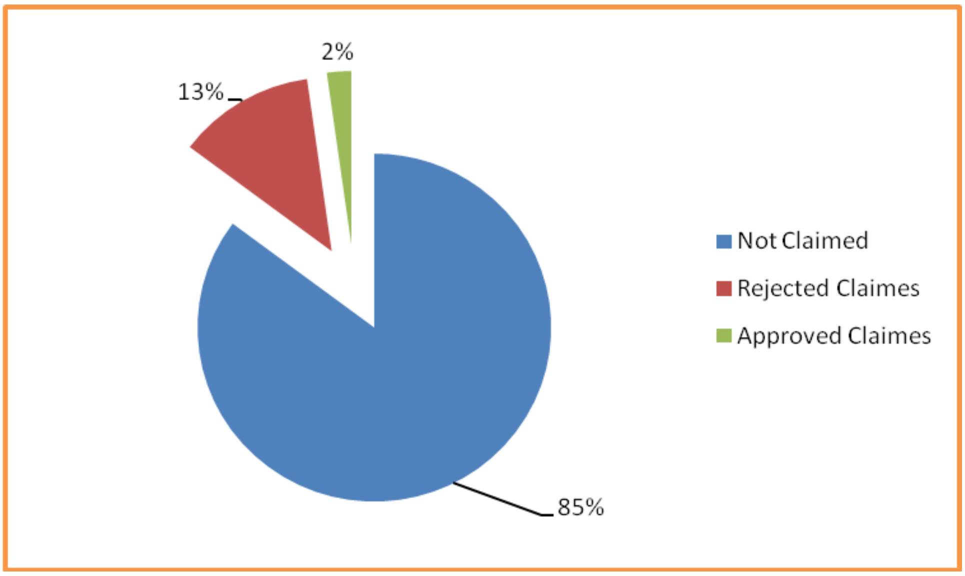


Source: Primary survey

In general, the Agariyas are not against the conservation of wild ass. At the same time, some of them are worried about their livelihood due to the fear of a possible eviction from the LRK. Today, governing the livelihood of salt pan workers is the most important challenge in the context of wild ass conservation. The policy needs to address issues so as to achieve a balance between conservation and livelihood concerns of Agariyas. Recognising of the present salt production as a livelihood source and the areas under salt production as salt zones, merits prime attention in this respect.

Addressing the livelihood concerns of the 26 percent of the Agariyas is very important to gaining local support for conservation efforts. This is especially true considering that their objection is mainly because of a possible threat to their livelihood. Recognising the land rights of Agariyas is an important issue in respect of the LRK. The issue of land rights assumes a greater significance in the context of the establishment of Wild Ass Sanctuary (WAS) in 1973. It has remained a contentious issue in administrative and academic circle since the formation of WAS. The chronologically arranged information related to land rights of Agariyas as given by Bharwada and Mahajan (2008) shows that Agariyas livelihood concerns did not receive much attention in the process of establishing a wild life sanctuary although there exist evidences to show the use of the LRK for traditional salt production by Agariyas. It is reported that the Rann of Kutch, laying in the north of Kathiawar and north east of Kutch state, has been exploited for the manufacture of salt from times immemorial and that many smaller works used to function prior to the advent of the British rule in India (Aggarwal, 1936). It is also reported that as an incentive for salt production, the government India promoted a policy of no permit or licence to Agariyas as they happened to be small and marginal groups in salt production. They were allowed to produce salt anywhere provided the area was less than or equal to 10 acres. Therefore, registering themselves with the salt department was optional to them. Some of them chose to register themselves, while others did not. The unregistered salt producers later became unrecognised salt producers of the LRK (Bharwada and Mahajan, 2008).

Figure 5.2: Recognition of Agariyas Land Rights



Source: Primary survey

Today, the land rights settlement officer in the LRK has taken a stand based on the registrations done in the past with the result that a number of Agariyas dependent on the LRK for their livelihoods, find themselves excluded. The customary rights of Agariyas have got ignored in this process (see Bharwada and Mahajan, 2008 for views in favour of customary rights). A lower bound estimate shows that 85 per cent of the Agariyas have not got an opportunity to register their claims (Figure 5.2). The unsettled rights of Agariyas remain a major challenge towards ensuring their livelihoods Since LRK comes under the forest land owned by the forest department, the Indian forest rights Act 2006 also becomes relevant in this context. But so far very limited efforts have been made to examine the rights of salt pan workers in the context of forest rights Act. Two important questions arise here: (a) whether Agariyas come under the category of forest dwellers as defined in FRA 2006; (b) Whether salt production comes under the livelihood activities as mentioned in the Indian Forest Rights Act? This needs to be examined and studied further. But one way of addressing these issues is to recognise Agariyas as a forest dwelling community under the Indian Forest Rights Act. The risk of a possible eviction from the LRK through notices issued by the Revenue Officer (Mamlatdar)-keeps disturbing their peace of mind and as a result, they spend a lot of time on dealing with bureaucrats just to solve the issue temporarily. This issue is prolonging since many years now. The land rights have not been settled even after 40 years of the formation of Wild Ass sanctuary. This study has noticed that eviction notices do not help the conservation causes. Instead, there is more hatred generated leading to an all-out objection to conservation initiatives. Therefore, we strongly feel that more importance is to be given to interactions with the public and also the governance of the livelihood system to generate a favourable support towards conservation initiatives.

Table 5.3 : Information related to the establishment of WAS and recognition of land rights (A summary)

Year	Events favouring recognition of Agariyas rights	Events in favour of Wild Ass Conservation	Remarks
12th Jan 1973		First notification of Wild Ass Sanctuary (WAS) in LRK (3569.36 sq. km) and 1271.54 sq. km of government waste lands. Total area of WAS 4840.90 sq. km Notification No GH/KH/13?WLP/ 1972/79736.P	Total 84 fringe villages

13 Jan 1978	Second notification to extant total area of WAS by adding 112 sq. km to make total sanctuary area to 4953.71 sq. km. Notification No GKH/78/WLP/ 197611118989191	Total 102 fringe villages
1978 to 1997	State government appointed settlement officers for verification of the rights and demarcation vide letter number WLP/ 3096/1642/G and constituted a committee consisting of three additional chief secretaries to examine the issue of WAS	A period of various public interest litigations for (more details see (Bharwada & Mahajan, 2008)
28 April 1997		
15 July 1997	State Government Committee Recommended an ecological study of LRK	
25th September 1997 State government issued notification to claim rights of LRK within 60 days		No claim registered due to various administrative reasons (e.g. 2nd feb 1998 letter of addition collector of Patan district to repeal notification and 4th July 1998 letter from the deputy secretary of forest and environment recommending withdrawal of Patan collectors rights to verify land rights
24th October 1999	Commissioned an ecological study to GEER foundation Letter No WLP/ 2079-80	

March 19999	GEER foundation completed an ecological study	
November 1999 to November 2006		A period of eviction notices, fines to Agariyas
November 2006 to 2007	Agariyas getting organised and informed about customary rights and begins to send claims to district collectors	NGO involvement, trade unions and awareness programmes helped them organise themselves
Jan to Dec 2007	Agariyas rights rejected on the ground that they did not claim within the stipulated time given i.e., 25th September 2007	
March 2007 to 2007 to present	A process started to negotiate Agariyas rights to produce salt in four salt zones of LRK.	AHRM has taken a lead in negotiating Agariyas rights

Source: (Bharwada and Mahajan, 2008)

5.4 Conclusion

The LRK remains characterised by a unique ecosystem with saline deserts and wetlands with a high biodiversity value. The LRK ecosystem provides various direct and indirect services to the human society besides habitats for the endangered Wild Ass species endemic to the region. The promotion of a livelihood augmentation programme using resources from the LRK must respect the status of the ecosystem. It is also important for the forest department to realise that the most important governance challenge in the LRK is livelihoods. Short term measures like sudden evictions and policing might prove counter productive to the conservation initiatives.

Chapter-VI
Summary and Conclusion

The concept, 'livelihood', has been extensively discussed in academic and development practitioners circles. The most widely used definition of livelihood stems from the work of Robert Chambers and Gordon Conway (1992): 'a livelihood comprises the capabilities and assets including both material and social'. The later modification of the definition shows 'a livelihood gained by an individual or household is jointly determined by 'the activities, assets, and access to resources'. The basic characteristic of the discourse on livelihood is the consensus that it is about the ways and means of 'making a living'. The livelihoods of Agariyas depend up on what they own. They own very limited productive assets such as agricultural land, livestock etc. The most important asset they own is their own labour with traditional knowledge and skill to produce salts. The only chance to utilise their labour power is when they migrate to the LRK for a period of 9 months; they can earn income by producing salt or working in others' salt farms. The money earned out of traditional salt production or wage labour is the main source of income that supports their livelihoods for the entire year. Nevertheless, they face a number of challenges in eking out a living from salt production. First, the restrictions imposed by the department of forest on their access to the LRK as part of wild Ass conservation. The main argument is that expanding salt production might adversely affect the habitats of Wild Ass. The second challenge they face is the scarcity of brine for producing salt, though it is not yet common in all parts of the LRK. The other factors that influence their livelihood insecurity are salt market imperfections and debt trap. Recognising the land rights of Agariyas is an important issue in respect of the LRK. The issue of land rights emerged as part of establishing a Wild Ass Sanctuary (WAS) in 1973. It has remained a contentious issue in administrative and academic circles since the formation of WAS. During the salt season, they are exposed to the direct sunlight of the desert with temperature above 45 degrees in day time. There is a high chance of occupation and environment related illnesses breaking out during this period. Secondly, Agariyas' children lack educational opportunities during the season since they miss regular classroom teaching in the desert. The life in the desert is in a low level equilibrium that is characterised by low income, poverty, occupational illness, and fewer opportunities for education.

Incidences of high poverty, malnutrition, lack of basic amenities are attributed to this low level of living. Therefore, the basic objective of the study was to examine the techno-economic viability of salt production and to find ways to improve their livelihoods without compromising on the conservation needs of the LRK ecosystem. The study finds an immense scope for improving the livelihoods of Agariyas without compromising on the biodiversity conservation concerns. From the analysis, it is clear that livelihood augmentation of Agariyas in terms of improved incomes is possible by improving the quality of salt through brine management and developing market strategies (not good to use etc. here). The livelihood security can be ensured through institution building to correct market imperfections and risks involved in the production of salt. The study has noted that Agariyas take all possible steps to maximise the quantity of salt production rather than quality since it is seasonal besides being subject to various natural risks. They are not paying adequate attention to improving the quality of salt because there is no guarantee of getting a better price for quality salts in the local markets due to high market imperfections. During the course of production, they face risks from nature, market as also eviction threats. Unexpected rains, declining brine yields, fatal gases from wells and high velocity winds are the main natural risks. Market imperfections and price volatility often create problems in selling the output on time. The risk of a possible eviction from the salt zones due to conservation of wild ass is also creating fear of losing livelihood sources permanently. All these factors act as a downward pushing force in respect of Agariyas' livelihoods, keeping them in a low level equilibrium. Therefore, in this context, livelihood augmentation simply means lifting them from the low level equilibrium position, through various actions at the farm level, while focusing on technology, awareness about scientific methods of production etc. In this respect, the study recommends the following short term and long term measures to bring about an improvement in the livelihoods through ensuring livelihood security and striking a balance between livelihoods and conservation. The recommendations focus on three aspects: (a) improving livelihoods by way of improving the quality of sodium Chloride;(b) improving livelihoods through extracting non-common salts; (c) securing livelihoods through a collective approach towards the local market; (d) securing livelihoods by pooling risks through their own organisations; (e) achieving a balance between conservation and livelihoods.

The availability and chemical composition of the brine are the key factors to the success of salt production in terms of maximising quality output. The deficiency of sulphate in brine is a concern while introducing measures to improve the quality of brine. The precipitation of calcium sulphate (Calcium sulphate $2H_2O$) gets delayed due to a low level of sulphate in the LRK brine. Sometimes, calcium sulphate crystallises simultaneously with sodium chloride, adding impurities to it. This is one of the crucial issues that requiring to be addressed for improving the quality of NaCl. These can be addressed by way of introducing scientific training and awareness building in brine management. In this respect, the collaborative works of AHRM and CSMCRI in Rajula can be a model for the LRK.

Agariyas are not very keen on producing calcium sulphate due to a low price it commands in the market and a relatively high opportunity cost of labour in the extraction of Calcium sulphate. These act as a disincentive for Agariyas to extract calcium sulphate. Agariyas are also unaware of the advantages of removing Calcium sulphate before the recovery of common salt. At present, the percentage of Calcium sulphate in common salt (NaCl) remains at higher levels as an impurity, affecting its quality. The removal of Calcium sulphate can improve the quality of common salt, in addition to fetching a high price in the open market. But, a minor change in the quality of NaCl would not make any difference to the price due to market imperfections and the role of middlemen. .A price change can happen only when the quality of common salt is improved to the industrial grade. Therefore, any interventions in the extraction of gypsum must consider its two aspects of production and marketing: (a) Agariyas' ignorance about the scientific advantages of gypsum recovery for improving the quality of NaCl; (b) gypsum recovery must be linked to a programme for improving the quality of sodium chloride to the industrial grade so that they get high benefits from the market. Therefore, it is important to impart training on brine management for extracting calcium sulphate.

We also have noted that the production of low quality salt along with gypsum can add more value to the production of industrial grade NaCl in the LRK. The field level experiments (using sea brine) by AHRM and CSMCRI also show a successful recovery of sulphate of potash from bittern. Sulphate of potash is a highly valued commodity in India as it is a net importer of potash. The recovery of potash from bittern is found to be the cheapest and easily available source of potash for the fertilizer Industry in India. Farm level experiments need to be promoted in the LRK to explore the possibility of extracting sulphate of potash particularly in areas that are close to the sea.

Another important salt is crystalline magnesium chloride (Suya). The current method of production results in high levels of impurities and, therefore, it is sold at low prices. There is an immense scope for augmenting the livelihoods of Agariyas through extracting crystalline magnesium chloride (Suya).The extraction of non-common salts need to be promoted through measures like capacity building programmes.

The production preference of Agariyas lies with Vadagara type of salt which is big in crystal size. Different lab tests have already proved that this variety has high levels of impurities compared to Karkachh and Poda varieties. This variety of salt with high levels of impurities is difficult to iodise. The promotion of Vadagara is still a contentious issue. Moreover, there is a high livelihood risk involved in a complete ban onVadagara production. Therefore, the first and best solution is to improve Vadagara production through better management practices. In this respect, the recommends further scientific studies on the iodisation process of Vadagara salt and its health impacts. The promotion of Karkachh has been suggested as a second best solution to improving salt quality and thereby livelihoods of the people because it can lead to more frequent truck movements which in turn, however, can affect the conservation objective. The promotion of Karkachh needs to be considered after a study on its impact on wild Ass conservation. Karkachh should be promoted in all zones of the LRK only after examining the adverse impactsits production can have on wildlife.

The distribution of cost across materials and labour shows that crude oil cost for pumping subsoil brine takes a major share followed by family labour. This gives an indication that the cost minimisation strategies of salt production should focus on saving crude oil consumption. The promotion of energy saving methods of production and the use of alternative sources of energy might help them reduce the cost of production. A further investigation may be promoted in this direction. The cost can be minimised in various ways such as minimising wasteful charging of brine to condensers, adopting measures to stop percolation of brine, minimising extra costs on additional wells in distant places etc. It is recommended that educational or training programmes for Agariyas can help minimise the activities that generate wasteful expenditures in the process of salt production.

Adding more number of wells or deepening the existing wells for pumping additional quantity of brine only adds to an increased consumption of crude oil in the production process without addressing the issue of brine scarcity. Agariyas need to be discouraged from digging more number of wells at distant places from their farms.

The market imperfections, through local traders' collusion, keeps the farm gate price of salt at low levels which, in turn, affects the livelihoods of Agariyas, leaving them with no surplus or sometimes even with a loss. The debt trap created by traders through advance lending makes Agariyas vulnerable to risks, which act as a downward pushing factor in respect of income, resulting in a livelihood insecurity. Addressing natural and market risks through institutional mechanism is a primary condition for ensuring the livelihood security of Agariyas. A practical study in this direction, particularly focused on institutions like AHRM is recommended. Considering that the local traders are very strong and united, it is not easy to reform the salt market through government policy changes. However, collective efforts on the part of Agariyas can improve their bargaining capacity. Therefore, this study recommends collective efforts to improve their bargaining capacity as well as for pooling various types of risks and developing now marketing strategies.

Finally, the promotion of a livelihood augmentation programme, using the available resources of the LRK must respect the status of the ecosystem. It is also important for the forest department to realise that the most important governance challenge in respect of the LRK is the livelihoods of salt pan workers. Short term measures like immediate evictions, policing etc can prove counterproductive to conservation initiatives. The study could not find any significant external cost of salt production on wildlife. Besides, the present system is found to be more traditional and wildlife conservation-friendly. The elicitation of environmental preferences of Agariyas also shows that they are not against the conservation of wild ass; but some of them are worried about their livelihood due to the fear of a possible eviction from the LRK. Governing the livelihoods of salt pan workers is the most important challenge in the context of wild ass conservation. The policy need to address all such issues so that there is a balance between conservation and livelihoods of Agariyas. Recognising the present salt production as a major livelihood source and the areas under salt production as salt zones merits a prime attention in this respect. It is important to recognise salt zones under the wildlife management plan as a space supporting local livelihoods. It is also important to recognise Agariyas as a forest dwelling community under the Indian Forest Right Act 2006. The risk of a possible eviction from the LRK has been disturbing the Agariyas which may hinder the conservation initiatives. The non-settlement of the land rights even after 40 years of the declaration of the sanctuary has remained a major concern which needs to be resolved on a priority basis. The eviction of salt pan workers from the LRK does not seem to be a practicable solution. Interactions between Agariyas and the State can lead to a more meaningful governance system in the LRK. The issue should be addressed by taking both the livelihoods and conservation concerns into consideration. An action plan needs to be developed in this direction.

Appendix

Table 1- A Quality Parameters of Common Salt

SINo.	Characteristic	Requirements	
		Refined Iodised Salt/ Vacuum Evaporated Iodised Salt	Iodised Salt
i)	Moisture, percent by Mass,Max.	0.5	6.0
ii)	Water in soluble matter, percent by Mass,on dry basis,Max.	1.0	1.0
iii)	Chloride content (asNaCl).percent by Mass, ondrybasis,Min.	98.5	96.0
iv)	Matter soluble in water other than Sodium Chloride, percent by mass,ondrybasis, Max.	1.0	3.0
v)	Calcium(asCa), percent by Mass, on dry basis, Max.	0.15	-
vi)	Magnesium (asMg), percent by Mass, ondry basis, Max.	0.10	-
vii)	Sulphate (asSO,). percent by Mass, Max.	0.60	-
viii)	Iodine content, ppm, Min.		
	Manufacturer's level	30	30
	Distribution channel in cluding retaillevel	15	15
ix)	Alkalinity (asNa,CO,), percent by Mass, Max.	0.15	0.15
x)	Lead (asPb).ppm, Max	2.0	2.5
xi)	Arsenic (asAs).ppm, max.	1.0	1.0
xiil	Iron (asFe), ppm, Max.	50	50

Source: BIS (2006)

References

Aggarwal, S. C. (1936). The Salt Industry in India Part I. Delhi: Goverment of India.

Babbar, V., Pathak, B., Chopra, P., Kaushik, V., Tembe, S., & Dave, J. (1994). Current Ecological Status of Kachchh. Vadodara: Gujarat Ecological Commission.

Bharwada, C., & Mahajan, V. (2008). Yet to be Freed: Agariyas life and Sruggle for Survival in the Little Rann of Kutch. Ahmedabad: Sandarbh Studies.

BIOS (2006) Indian Standard: Iodized Salt Vacuum Evaporated Iodized Salt and Refined Iodized Salt-specifications (Second Revision), Bureau of Indian Standards, New Delhi.

Carney, D. (1998). Sustainable rural livelihoods: what contribution can we make? London: Department for International Development.

CESC. (2006). Biodiversity Conservation and Rural Livelihood Improvement Project: Little Rann of Kutch Indicative Plan. Ahmedabad: Centre for Environment and Social Concerns.

Chambers, R., & Conway, G. (1992). Sustainable rural livelihoods: practical concepts for the 21st century. Brighton: Institute of Development Studies.

Champion, H. G., & Seth, S. K. (1968). A Revised Survey of the Forest Types of India. New Delhi: Goverment of India.

CSMCRI. (2010). Salt Production in the Little Rann of Kuch: Paper Presented in the Project Initiation Workshop Ahmedabad . Ahmedabad .

Dixon, J. A., & Sherman, P. B. (1990). Economics of Protected Areas. Washigton DC: Island Press.

Ellis, F. (1998). Survey article: Household strategies and rural livelihood diversification. The Journal of Development Studies, 35(1), 1-38.

Ellis, F. (2000). Rural Livelihoods and Diversity in Developing Countries. Oxford: Oxford University Press.

Francis, E. (2000). Making a living: changing livelihoods in rural Africa. London: Routledge.

Francis, E. (2002). Rural livelihoods, Institutions and vulnerability in North-West Province of South Africa. Journal of Southern African Studies, 28(3), 531-550.

Ganguly, V. ((undated)). Living conditions of salt workers in Kutch. Ahmadabad: Oxfam (India) Trust.

Ghaudhari, B. P., & Mehta, P. R. (1965). SRI, 2(3), 103-105 Central Salt and Marine Chemical Research Institute.

GoI. (2012). Annual Report 2011-12. Ministry of Commerce and Industry, Salt Department. Jaipur: Government of India.

Hussain, S. A., & Roy, R. (1993). Directory of Indian Wetlands. New Delhi: WWF-New Delhi and AWB-Kuala Lumpur.

Kurlansky, M. (2002). Salt: A world history. London: Vintage Books.

Mehta, D. G., Udvadia, N. N., & Kawa, B. M. (1965, October). SRI, 2(4), 139-140.

Mehta, P. R., & Bhatt, M. M. (1965, July).SRI.Central Salt and Marine Chemical Research Institute.

Mehta, P. R., Desai, G. J., & Gadre, G. J. (1967, January). SRI, 4(4), 20-21, Central Salt and Marine Chemical Research Institute.

Merh, S. S., & Malik, J. J. (1996). Kachchh Penisula and RAnn of Kuchchh. Department of Geology. Vadodara: M S University.

Narie, K. K. (1964, October). New salt works A-10. SRI Central Salt and Marine Chemical Research Institute.

Patel, G. D. (1971). Gujarat State Gazetteers (Surendranagar). Ahmedabad: Goverment of Gujarat.

Pesikka, P. N. (1964). New salt works A-15. SRI, 1(1), Central Salt and Marine Chemical Research Institute.

Rabalino, J. A. (2007). Land conservation policies and income distribution who bears the burden of our environmental efforts? Environment and Developmental Economics, 12, 521-533.

Raval, M. K., & Satyanarayan, K. V. (56 - 58). SRI, 4(2), 56-58.Central Salt and Marine Chemical Research Institute.

Sapre, K. P., Bhatt, M. P., & Bhatt, R. B. (1964, April). New salt Works A 10. SRI, 1(1), Central Salt and Marine Chemical Research Institute.

Sapre, R. K., & Bhatt, M. P. (1964, April). ,New salt works A-10. SRI, 1(1), SRI Central Salt and Marine Chemical Research Institute.

Sathyapalan, J., Srinivasan, J. T., & Easa, P. S. (2013). Biodiversity Conservation and Livelihoods of LRK. Hyderabad: Centre for Economic and Social Studies.

Sawaminathan, K. (1964). New Salt Works A-16. SRI, Central Salt and Marine Chemical Research Institute.

Shah, R. ((undated)). A pinch of Salt: A Study of Salt Workers of Rajkot, Surendranagar, and Patan District of Gujarat. Ahmedabad: Saline Area Enterprise Limited.

Sheshadri, B. (1986). Indias Wildlife and Wildlife Reserves. New Delhi: Sterling Publishers.

Sims, K. R. (2010). Conservation and development. Evidence from Thai protected areas. Journal of Environmental Economics and Management, 60, 94-144.

Singh, H. S., & Patel, B. H. (1997). Ecological Study on Wild Ass Sanctury and Surrounding Area using Remote Sensing Technology for Environmental Impact Assessment. Ghandhinagar: GEER Foundation.

Singh, H. S., Patel, B. H., Pravez, R., Soni, V. C., Shah, N., Tatu, K., & Patel, D. (1999). Ecological Study of Wild Ass Sanctury. Gujarat Ecological Education and Research Foundation. Ghandhinagar: Gujarat Ecological Education and Research Foundation.

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