Policy Research Journal
ISSN (E): 3006-7030 ISSN (P) : 3006-7022 Volume 2, Issue 1, 2024

CLIMATE SENSITIVE LIVELIHOOD MODELING FOR RESILIENCE OF COASTAL COMMUNITIES RESIDENCE IN THATTA AND SUJAWAL SINDH PAKISTAN

Mukhtiar Ahmed Mahar[*1], Maheen Memon[2], Rafique Ahmed Memon[3], Abdul Khalique Mallah[4]

[*1,3]*Centre for Coastal and Deltaic Studies, University of Sindh Campus Thatta, Makli, Sindh, Pakistan*
[2]*University of Exeter, United Kingdom*
[3]*Deputy Commissioner Office Sujawal, Sindh, Pakistan*

[*1]mukhtiar.mahar@usindh.edu.pk, [2]memonmaheen9@gmail.com , [3]rafique.memon@usindh.edu.pk, [4]abdulkhalique.mallah@gmail.com

DOI: https://doi.org/10.5281/zenodo.23158934

Keywords
Sindh coastal zone, climate resilience livelihood modeling, mariculture development

Article History
Received: 27 December 2023
Accepted: 15 January 2024
Published: 30 January 2024

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Corresponding Author: *
Mukhtiar Ahmed Mahar

Abstract

Sindh coastal districts Thatta and Sujawal are disaster prone areas where several hazards hit communities' lives and assets. Therefore, proactive measures are necessary on urgent basis for recovery. Climate sensitive livelihood modeling in the form of smart agriculture, aquaculture, livestock, dairy and poultry are the important factors which help directly to uplift the economy of coastal communities. The income of households indicated unskilled labour (22%), skilled labour (19%), agriculturist (08%), fishing (34%) Livestock and dairy (10%), Poultry (4%) and fourth was private jobs (12%) however 60% households were untrained therefore seeking the need for technical training to start the cottage livelihood options such as cattle farming, vegetables cultivation, fish culture, poultry, mangrove nursing, and handicraft making. If coastal communities may have been given the opportunities of technical training, loans without interest and proper facilities related to their skills they become stable financially with equality to the urban area. It is fact that Sindh coastal zone is highly productive in relation to natural resources. If the coastal communities are given the chance for developmental sides, they work hard and prove the role in the development of economy of the country. Climate resistance, culturable fruits, vegetables, grains (wheat, rice, peas, barley etc.), animals, fish species, crabs, shrimps, poultry, should be introduced in the area. In this connection government sector, research organizations and academia come forward and play a vital role for the development of marine, coastal and deltaic zone of Sindh, Pakistan. The results indicated that 34% coastal communities are engaged in fishing professions, therefore under the umbrella of Marine Research Laboratory and Survey Unit Sujawal they can start the cultivation of climate resistance indigenous fish species, mud crab farming and fattening, shrimp farming, oyster and mussels cultivation, mangrove nursing, razor clam farming and growing of artemia cyst under controlled condition. These are the best and sustainable practices for better livelihood options for coastal communities.

INTRODUCTION

The study on climate sensitive livelihood modeling (CSLM) was carried out in two coastal districts Thatta and Sujawal. The aim of study was to visualize strengthening the coastal communities impacted by climate change inverse situation against the depletion of livelihood options especially agriculture, fisheries, livestock, poultry and other matmaking assets.

THATTA DISTRICT

In terms of agriculture, livestock, fisheries, trades, industries, and sociocultural factors, Thatta district is among the most productive in Sindh Province (Fig.1). Over 0.3 million people reside in the Thatta district's Mirpur, Ghorabari, and Keti Bundar, a lengthy coastline taluka. The hydro-meteorological threats they face include sea level rise, coastline erosion, frequent cyclones, degradation of the Indus River delta, sea incursions, soil degradation, floods, droughts, and the overall loss of a once highly productive ecosystem due to changing climatic patterns. The effects of pollution, freshwater scarcity, and climate change on coastal and marine biodiversity are seen to be detrimental when considering the local natural resource condition (Rabani, 2018). Compared to inland areas, this coastal belt was once extremely prolific and fertile. Over the past few decades, unexpected and rapid rainfall patterns in Sindh's coastal districts have frequently drastically altered both the hydrological cycle and the coastline morphology. Sea level rise, sea invasions, and warming of ocean water bodies make coastal communities more vulnerable, even if rising earth's surface temperatures are changing wind and rain patterns worldwide. During recent two decades high intensity cyclones, extreme monsoon rains and major floods in 2010 in Pakistan resulting in enormous loss to life and property. Millions of acres of agricultural land and water resources in the region have been destroyed by marine invasions alone, resulting in acute food and water shortages. Despite all this, there is significant lack of policy measures and governance structures to address issue of climate migrants in Pakistan. The fishing business has contributed to the promising future socioeconomic circumstances of over 50,000 coastal families. As a result, there is a query. Consequently, sustainable fishing communities. Consequently, sustainable fishing communities. Thus, sustainable fishing, sustainable fishing, sustainable fishing communities. The most important need of the day is awareness of undersized catch, unsanitary storage, and illicit, unreported, and criminal fishing methods and gear. If this doesn't happen, the native species will quickly become threatened, endangered, and extinct. The goals will be to visit, educate, and train fishing communities through an ongoing survey schedule.

SUJAWAL DISTRICT

The Sujawal district is situated in Sindh, Pakistan, in latitude 68°4′45°E and longitude 24°36′11′N at the end of the Indus River (Fig.2). On October 12, 2013, it attained full district status (Wikipedia En., 2020). It is located at the point where the Indus River empties into the Arabian Sea on its left bank. The Sujawal district covered roughly 55 kilometers of coastline. The district is home to four significant creeks: Gaghiar, Khar, Wari, and Khajar. These creeks are productive and sustain mangrove forests, which serve as a natural breeding ground for thousands of marine animals and the final crossing point of Sir Creek at the Pakistan Indian border. Two times in a 24-hour period, the six-hour high tidal motions go downstream toward the sea and toward marine water on mudflats. It is well recognized for its high-water elevation, which occurs in relation to the earth's gravity and that of the moon. A network of Indus River creeks connected to the Arabian Sea on the left bank of the Indus delta eco-region, which serves as a natural spawning ground for thousands of marine and non-marine living organisms, dominates the coastal area environment of Sujawal district (Latif, 2005).

Currently the marine biodiversity of Sindh coastal areas in general and Sujawal district in particular are facing serious threats due to climate change, sea intrusions, reduction in Indus River flows, and over exploitation of natural living and non-living resources. Over the past few years, there has been

a significant decline in the quality of soil, surface waters, and ground water, which has had a negative impact on the socio-economic structure of Sujawal district commanding region (Muhammad Hussain Khan, 2015). About 40% of coastal populations are engaged in fishing using traditional ways, therefore the proposed research will provide new venues in fish cultivation approaches (Tribune, 2019). The socio-economic status of coastal communities, the biodiversity of the coastal and marine environment, and the creation of recommendations for the development, conservation, restoration, and protection of coastal resources and assets that impact human lives are the goals of the current study.

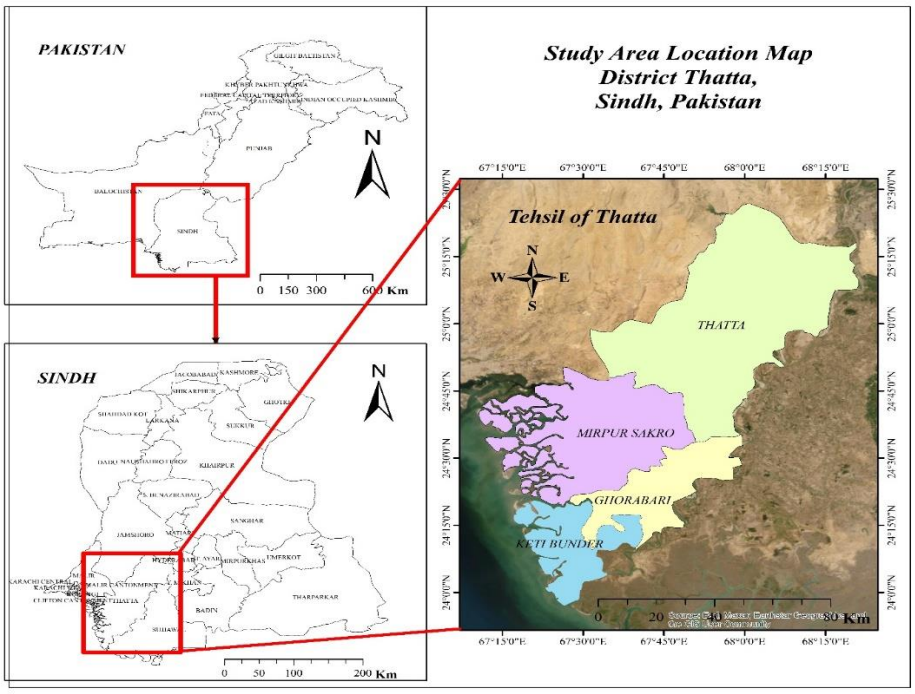


Fig.1. Map of Thatta district showing coastal zone and tehsils

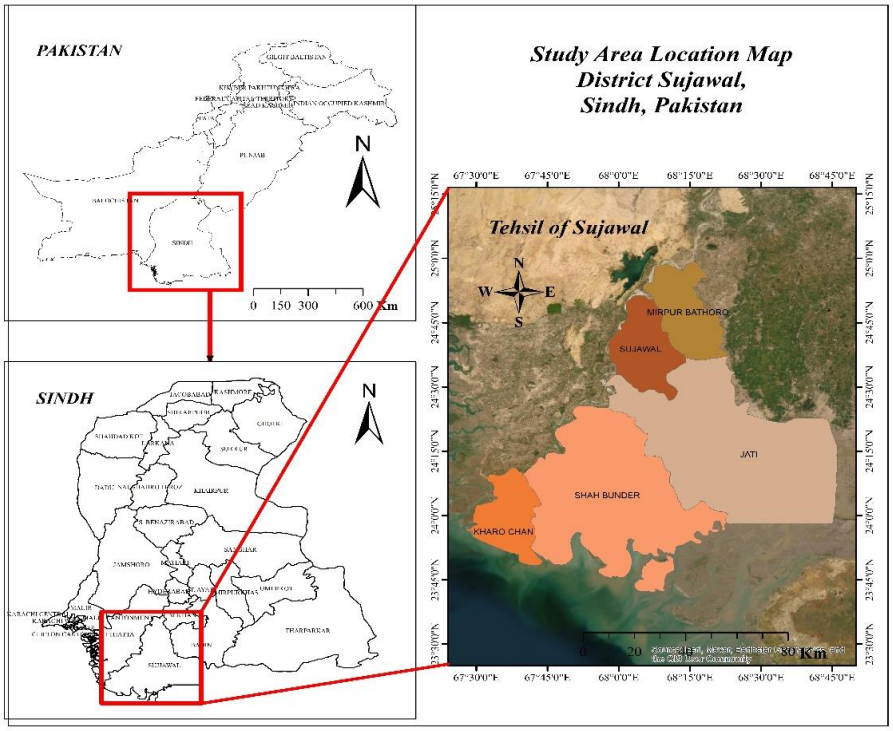


Fig.2. Map of Sujawal district showing coastal zone and tehsils

MATERIALS AND METHODS

A comprehensive survey of the area was conducted at the beginning of the marine research project. In this regard, the baseline investigation was carried out using both quantitative and qualitative methods. Random sampling procedures were used to acquire data for the quantitative element. In this connection 500 individuals (sample size) of House Holds were collected from the coastal zone of both the districts. Twenty (20) Key information interviews (KIIs) and fifty 50 Focus Group Discussions (FGDs) were conducted. Preferably, the ODK and KOBO software were used for data analysis and results accumulations. The estimated samples were subsequently divided into various clusters and strata. The target population of UCs' proportionate distribution was a determining factor. Key information interviews (KIIs) were conducted with ten distinct but important stakeholders and for each interview, unique questions of interest were specified in the form of tool. The program team was consulted to determine the list of stakeholders. Focus Group Discussions (FGDs) were arranged at the community level. The responses were recorded and documented in the same detail as the respondents' shared responses. The expert used clever, methodical techniques to exercise the triangulation of data.

RESULTS

The focus group discussions (FGDs), key informant interviews (KIIs), small gatherings (SGs) were organized at main headquarters of Taluka Mirpur Sakro, Ghorabari and Keti Bander in district Thatta, while in district Sujawal Taluka Jati and Shah Bandar.

DISTRICT THATTA

Fisheries (40%), agriculture (25%), and other industries including business and government work (35%) are the main sources of income for many communities in deltaic regions. Almost all the disasters, including summer monsoonal and cyclone-related rainfall, drought, water scarcity, salt, soil degradation, and seasonal climate-related changes, have a significant impact on this area. The area is particularly sensitive to soil

deterioration from seawater intrusion, which has significantly damaged the socioeconomic situations of the residents, as well as local unpredictable and uncommon rains and recent climate change. The government and a small number of population pockets Non-governmental organizations have a part to play in mitigating the negative effects of climate change, but much more is required to solve these persistent problems. The vulnerable groups need to be thoroughly educated/ equipped with scientific information and skills to address any calamity in their locations. Although various NGOs are onboard to combat the crisis on temporary programs, the responsible Government Departments should come forward on long lasting and uninterrupted action grounds to play their role with their full dedication and knowledge. With its resources based on humanitarian principles, Islamic Relief may identify the most vulnerable places where there is no government organization to operate in the areas of hunger, health, and education among the communities to promote sustainable economic and social development. The department concerned and organizations should strive relentlessly and continually to increase public knowledge of the growing effects of climate change in their communities in places where climate change and other social-related challenges persist. Nearly all the local and international NGOs operating in Sindh's and Pakistan's disaster-affected populations are perceived as being less connected to one another. They are perceived as operating independently. They are necessary to have utmost binding amongst for better operating. Only 20% of the coastal community has chosen to participate in the livelihood interventions that WWF Pakistan and IUCN have initiated by offering incentives such integrated aquaculture and crab fattening (IUCN,2019). The coastal climate and the ecosystems after 50 to 100 km are diversified. Some areas are arid, semi-arid, barren and some are fertile.

TALUKA MIRPUR SAKRO (THATTA)

In all, 13 FGDs were held in Mirpur Sakro. The participants were chosen to learn more about climate-sensitive livelihood possibilities and modelling for the community's bright future. This zone's settlements lack basic amenities and are underdeveloped. A small percentage of the community works in fishing, although agriculture, cattle, and poultry farming are their main occupations. Government and non-government employees make up a very small percentage of the population. There isn't a single significant hospital, high school, or government entity that can respond quickly to a disaster or quickly resolve a significant problem. Literacy rate of the community. Union councils are up to 15 or 20 kilometers away from the hospital. No appropriate long-term incentive from the government or other organizations. Total population of the union council is more than 2000 homes and registered voters. They sought basic education, health, road, drainage, water supply, adequate irrigation system, local market investment, employment, training, soft loans without interests to start any profession or boost the farm and animal production and enhancement of modern technology. They guarantee their assistance and potential participation if any group establishes a small cottage business pertaining to the community's staple goods, such as handicrafts, vegetable refineries, fruit packaging, water, juices, cold drinks, etc.

TALUKA KETI BANDAR (THATTA)

Taluka Keti Bandar was the location of the second discussion phase. There was a total group discussion. They recorded one by one by one by one by one with viewpoint. In response to a query regarding climate change, they explained that seasonal changes, temperature fluctuations, wind, precipitation, and the salinity of agricultural soils had all been noted. The crops are severely impacted by this phenomenon and are not producing the necessary amount per acre. Several diseases have also been reported in livestock, poultry, and other household animals. When comparing the current situation to earlier decades, they claimed that while we used to be content, we are now perplexed, even angry, and have decided to go to fertile locations where our alternatives for

living grow easier. Few of them mentioned that we cannot migrate to urban areas because of the housing rent, local travel, food, water, clothing and other daily utilities are too expensive thus beyond our capacity.

It would be better for us if the government or another organization could deliver a means of subsistence right to our door. Domestic, social, health, education, transit, washing, livelihood, food, and water issues have plagued us for a long time. During catastrophic calamities, we are temporarily assisted by the government, non-governmental organizations, and other institutions. But normally, nobody gives a damn about us. They also recommend that local types of crops, vegetables, fruits, livestock, poultry, and fodder for domestic animal developments be the subject of research experiments by the government, research organizations, and supporting NGOs. Local environment friendly climate resilient crops in agriculture sector and salt and temperature resistant crops and animals may be introduced. The people of union council need applied nature training for crop production, animal and dairy production, and poultry and fish culture development as better livelihood options. The women need trainings related to domestic handicrafts, tailoring. For these purposes small loans and soft incentives may be provided for better life span

TALUKA GHORABARI (THATTA)

The inhabitants of Taluka Ghorabari said that they are living miserable lives. Fishing community is also vulnerable in reducing fish stock due to climate actions. The creeks only bring jellyfish stocks that are clear indication of high salt, temperature alteration and increase suffocation in sea. Thus, the bulks of jell according to the residents of Taluka Ghorabari, their lives are dismal. The fishing community is also at risk of a decline in fish stocks because of climate change. Only jellyfish stocks that are a blatant sign of high salinity, temperature changes, and increased marine suffocation are brought in by the creeks. Instead of relying on fish, prawns and crabs for their livelihood, fishing villages are gathering jellyfish blooms. Finfish and shellfish are absent from creek water. Fishing communities are collecting jellyfish blooms for their livelihood options instead of fish, shrimps and crabs. The water in creeks lacks finfish and shellfishery. Only small sized fish like mud skippers are surviving nowadays. If the situation remains same then in near future this fish stock might be extinct due to plastic pollution, industrial effluents and Karachi domestic waste. The marine life and natural aquatic living stock is at alarming stage may be in last few decades our coastal zone and seashore become barren. The fishing communities were of the viewpoints that due to climate change; their fishing, their livelihood, social standing, and health are exponentially at risk. They are vulnerable. They used to capture catch fish in the past. These days, we have altered, the other professions, the other professions, the other professions, the other professions, and now. This is because they cannot endure bears. Seawater intrusion affects freshwater lakes, ditches, and flooded areas. As a result, the lakes are now merging with the ocean. This is caused by the rise of the sea level and marine incursion. This is the ideal moment for the government, research institutions, non-governmental organizations, and civil society to step up and take the required actions to preserve the social, cultural, economic, and biodiversity of Sindh's old coastal zone. Everything is feasible if the State wants to change the situation and take the required actions.

TALUKA JATI (SUJAWAL)

Over twenty-five men took part. The participants were informed that freshwater availability is one of the union council's main problems. There is a severe freshwater deficit throughout the union councils. Due to the tidal action of the sea water in the Seer, Warri and Kajar creeks, this UC is subject to salt intrusion. Vegetables, fruit gardens, and other crops are grown in most agricultural areas. They added that salt is progressively causing harm to their homes. If possible, steps would not be taken timely then in near future full union council may be turned in saline. They further told that their houses are gradually damaged due to

salt. If possible, measures would not take timely then in near future whole union council may be converted in saline mudflat. They pointed out that about 70% of the inhabitants of union councils are agriculturists and fishing by profession now face huge problems of livelihoods. They demanded that climate; salt and high temperature resilient crops may be introduced at coastal zone especially at our union council. We consent to lend our land, space, and all available assistance for the pilot or experimental development of any project. We take great initiative in coordinating with the district government, legislators, NGOs, and other activists through our social working mechanism. As a result, we have great hope that something constructive will be done. Regarding issues related to education, health, transportation, and prompt response, they responded that the union council does not have a suitable system in place for schools, hospital roads, or government picketing. For immediate relief, we are visiting and joining the other union councils. Agriculture and cattle are currently our main sources of income, and both are currently in a fragile state. They recommended and asked the organizations to support livestock and agriculture. There is an urgent need for training, soft loans, locally published applied nature literature, and local jobs in companies, windmills, and government agencies.

TALUKA SHAH BANDAR (SUJAWAL)

Along with the awareness walk organizations, a total of twenty-five individuals from various categories took part in the targeted group talks. During the inspection, several observations pertaining to WASH, gas, electricity, roads, drainage, and street paver blocks were discovered to be damaged or non-functional. In terms of occupations, 70% of the community is made up of men and women who work in the labour sector, particularly in industries. There are no transit, health, or education amenities in this union council. Drinking water is the primary challenge of this area. During focused group discussion the community peoples asked to the TMA and district government to offer necessities and facilities that is the due right of each Pakistani citizen even he lives at any area of country. For men and women to begin self-employment in techniques, the NGOs advocated the creation of vocational technical schools and training facilities for short-term technical education diplomas. Poor folks may be eligible for interest-free soft loans so they can begin their careers smoothly. A transportation awareness walk was also planned after many people took part in targeted group talks. Many people took part. By drawing attention to the problems and difficulties posed by freshwater scarcity, pollution, overuse, climate change, and population growth. It is concluded that the coastal community adopted new tendencies, particularly the members of the planned union councils. They require technical education and training in a variety of applied fields so they can handle applications according to the union council's needs, opportunities, and availability of incentives. It is discovered that marine incursion has left a significant portion of agricultural land barren. As a result, it is recommended that governmental and non-governmental organizations introduce new varieties of vegetables, rice, wheat, and other quickly growing, environmentally friendly cash crops that are resistant to salt and high temperatures in accordance with needs and specifications.

ASSETS/ LIABILITIES/ SOURCES OF INCOME (LIVELIHOOD)

When research team asked question to the communities about their sources of income, the vast majority of survey respondents provided a variety of answers for example, 22% of respondents said they were unskilled labours, 19% said they were skilled labours, 14% said they were involved in fishing, 13% said they worked in private employment, 10% said they had no source of income, 9% said they were in the agriculture sector, 3% said they were in the poultry business, 3% said they worked for the government, 2% said they were in livestock, 1% said they worked in aquaculture, 1% said they were in the horticulture, and 1% said they received donations. The

information on income sources and the number of respondents connected to them in the districts is provided in Table 1.

Table1. Livelihood average income sources of communities at Thatta and Sujawal districts.

#	Source of Income	Taluka Thatta	Mirpur Sakro	Ghora Bari	Keti Bandar	Taluka Sujawal	Jati	Shah Bandar	**Total**
1	Agriculture	8	8	4	7	1	9	7	**44**
2	Aquaculture	3	4	8	9	4	7	8	**43**
3	Horticulture	3	2	4	5	8	4	6	**32**
4	Fishing	9	9	7	7	8	5	7	**47**
5	Government Job	7	6	3	4	8	5	4	**37**
6	Private Job	8	7	2	2	4	3	2	**28**
7	Livestock & Dairy	3	8	6	4	4	7	6	**38**
8	Poultry	4	2	2	1	3	2	3	**17**
9	Skilled Labour	5	8	6	9	8	7	8	**46**
10	Unskilled Labour	8	9	9	8	8	6	9	**62**
11	Small Enterprise	6	1	2	2	4	2	0	**17**
12	Donations	3	3	2	8	4	9	9	**38**
13	No Mention	7	9	8	5	9	2	6	**46**
	Total	**74**	**76**	**63**	**71**	**73**	**68**	**75**	**500**

Average monthly Income of coastal communities:

In terms of typical monthly income, 47% of respondents reported earnings between Rs.11,000/- and Rs.20,000/-, 22% reported earning between Rs.5,000 to 10,000/-, 13% reported earning between Rs.21,000/- to Rs. 30,000/-, and only 6% reported earning more than Rs.31,000/-. Most of the questions revealed that question revealed the findings of the average. This illustrates the financial situation of average-income households (Fig.3).

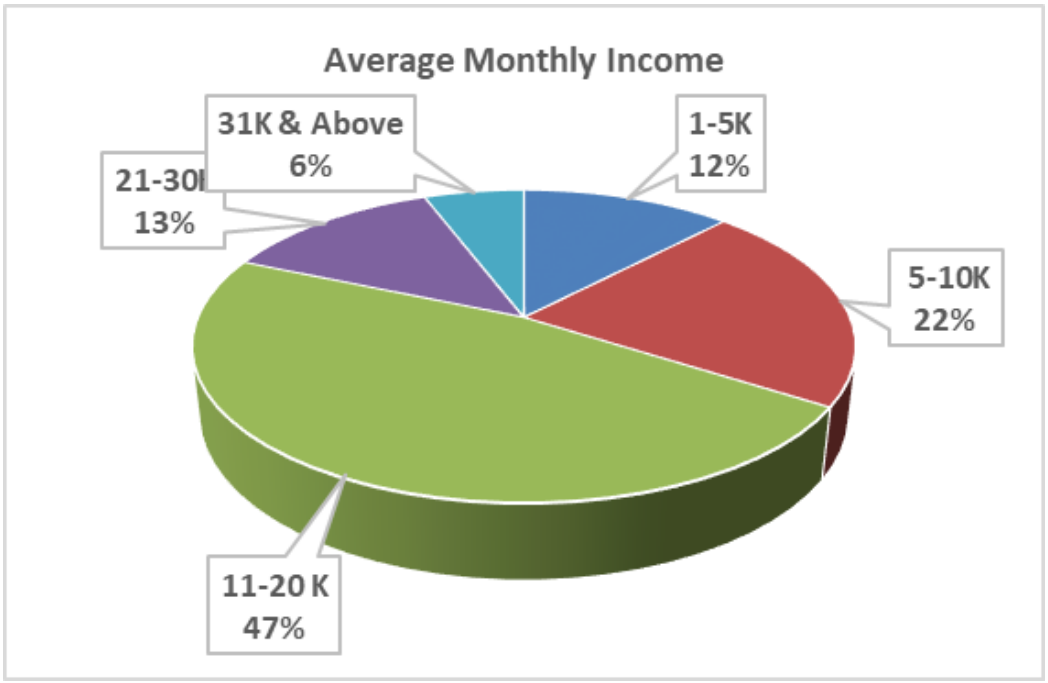


Fig. 3. Average monthly Income of coastal communities of Thatta and Sujawal, Sindh Pakistan

Ownership of Agriculture land:
When asked how much agricultural land do they own in acres, vast majority i.e. a number of 20 out of 44 households shared having 1-4 Acres of Agricultural land, 8 out of 44 shared they do not have agricultural land for cultivation purposes, 6 out of 44 had 11-20 Acres, 5 out of 44 had 5-10 Acres of land, 3 out of 44 had less than one Acre Agricultural land, while only 2 households had 21-30 Acres and 31 & Above Acres of land for cultivation (Fig.4).

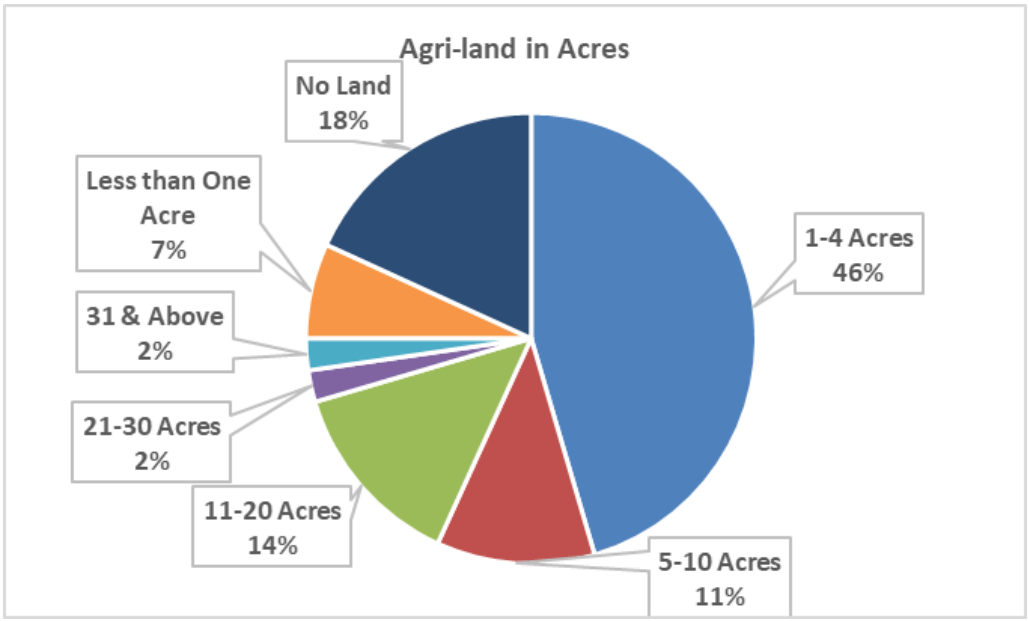


Fig.4. Agriculture land owned or rented by coastal communities Thatta and Sujawal

Status about fertile cultivating land/ barren:
The respondents were asked to share how many acres were they cultivating currently, in response to this question majority of the households i.e. (18 out of 41) informed that they cultivate 1-4 Acres of land, (12 out of 41) households shared that they do not have any land for cultivation, (3 out of 41) households shared that they cultivate 5-10 Acres of land, (3 out of 41) Households said they cultivate 11-20 Acres of land, another (3 out of 41) households informed that they cultivate less than one Acres of land while (2 out of 41) households said they were cultivating 21-30 Acres of land (Fig.5).

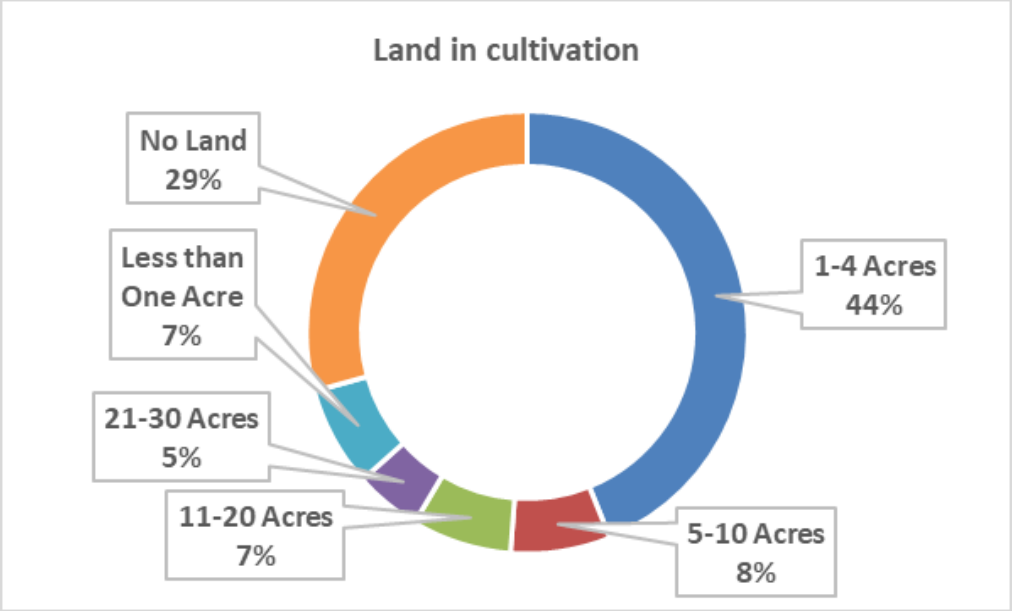


Fig.5. Cultivated and productive land of Coastal communities in Thatta and Sujawal

Status of livestock and dairy forms:
In response to this question, surprisingly majority of the surveyed respondents shared that they do not have any livestock. The situation was same across most of the households who responded to this question informed they do not have any livestock breed, households had Cows, households had Goats, households had Buffalos while households had Sheep's as breeds for raring. This again reflects the poor socio-economic conditions of local communities, where majority of the people from selected households do not have any livestock, however there are households with limited number of livestock to support their food security needs (Fig.6).

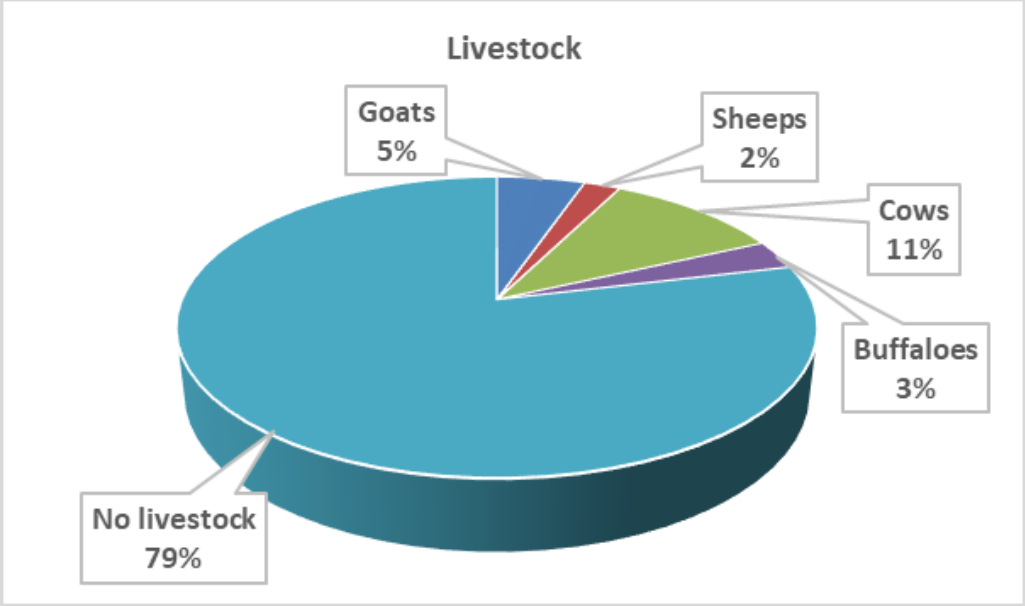


Fig.6. Status of Livestock and Dairy forms in Coastal zone of Thatta and Sujawal

Status of poultry farming at household level:
Majority of the households in response to the question whether they have poultry at their home declined to have any poultry at their homes, this includes (76%) households who said no and (24%) participants who said yes. The trend was similar in all targeted UCs except in the talukas of both the districts where the number of households having Poultry was slightly higher. Majority of interventions of small-scale farming carrying on soft free inters loans provided by a few NGOs working on spot (Fig.7).

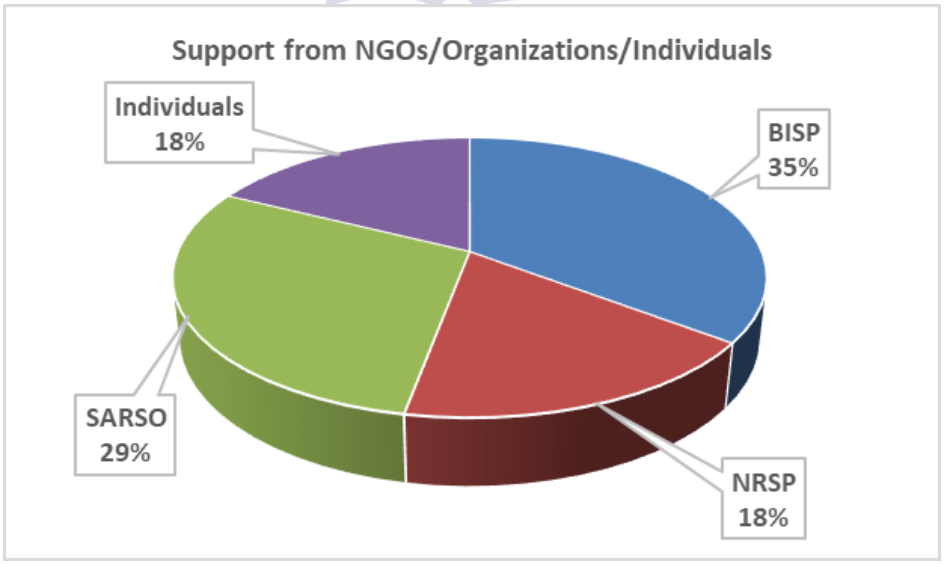


Fig.7. Status of poultry farming with support of different organizations

Status of Households skills development:
In response to this question interestingly several households shared a variety of skills in their family. This included a vast majority of the households having skills in, (38%) had skills in different field

mentioned here as other, (37%) households have family members skilled in Tailoring, (5%) households have family members were skilled in Masonry, (4%) households have family members were skilled in Shop keeping, another (4%) households have family members were skilled in Motor/Vehicle Driving, (3%) households have family members were skilled in Motor Mechanics, another (3%) households have family members were skilled in Beauty Parlor Business, (2%) households have family members skilled as Electrician, another (2%) households have family members skilled in Crab/Shrimp farming, (1%) households have family members skilled in Hair dressing, another (1%) households have family members skilled in Mobile phone repairing while (0%) households have family members skilled in Carpeting. This shows the variety of skills household family members brought with them (Fig.8).

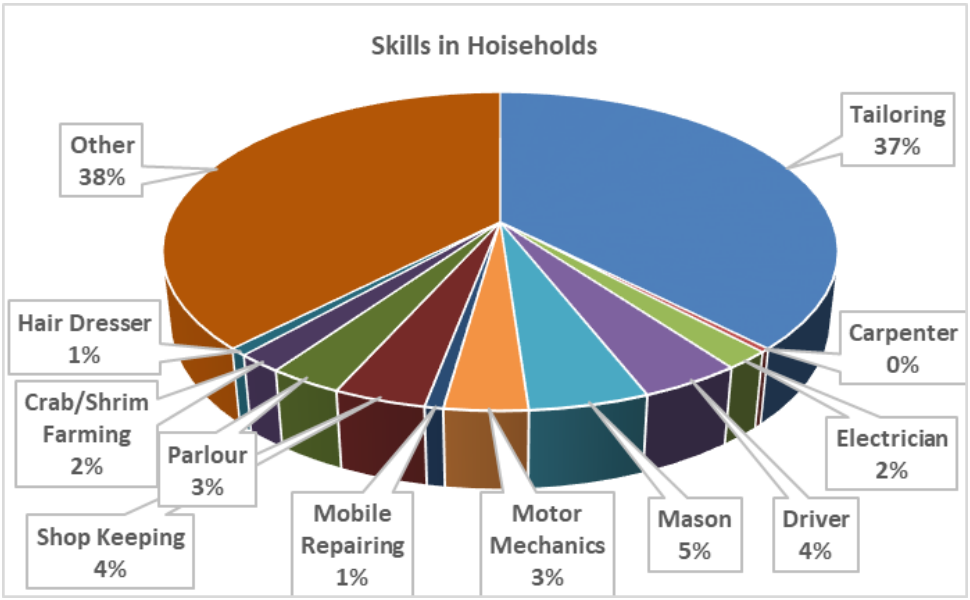


Fig. 8. Status of Households skills development

Climate impact on livelihood assets:

In response to this question interestingly several households shared several reasons as major causes for climate change. This included a big number of households i.e. (43%) who said it's an Act of God/God's will, (19%) said it's because of Pollution, (9%) were of the view that it's because of Deforestation, (8%) said they don't know, (7%) said that it's because of Ozone layer depletion, (5%) said that it's because of Livestock wastes, (3%) said that it's because of Burning of woods and debris, another (3%) said that it's because of Emission of transportation, (2%) said there can be other reasons, (1%) said that it's because of Green House Gases. This shows a variety of reasons people consider climate change (Fig.9).

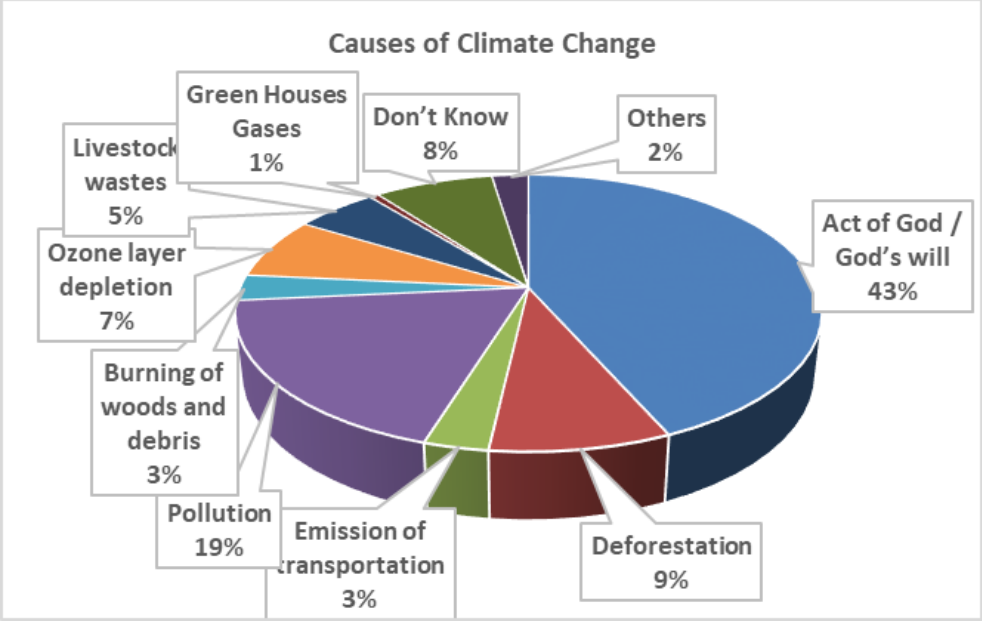


Fig.9. Climate change impact assessment on Livelihood assets of Coastal communities Thatta and Sujawal

Major impact of climate change on Livelihood:
In response to this question interestingly several households' shared different impacts for climate change phenomenon. This included a fairly large number of households i.e. (33%) who said that major impact of climate change is increase in temperature, (31%) said they don't know as they were not sure about the impacts of the climate change, (6%) said there might be other impacts of the climate change phenomenon, another (6%) cited droughts as the major impacts of climate change, (5%) referred to unexpected rails as the major impacts of the climate change, another (5%) named to climate induced interrupted flow of water/ flood as the core impact of the climate change, and another (5%) named to cyclone/storms as the main impact of the climate change, (4%) stated decrease in crop yield as the major impact of the climate change, (2%) shared migration due to limited income opportunities as the major impact of the climate change, another (2%) stated sea water intrusion as the major impact of the climate change while (1%) shared Bio diversity as the major impact of the climate change. This shows variety of reasons people consider for climate change (Fig.10).

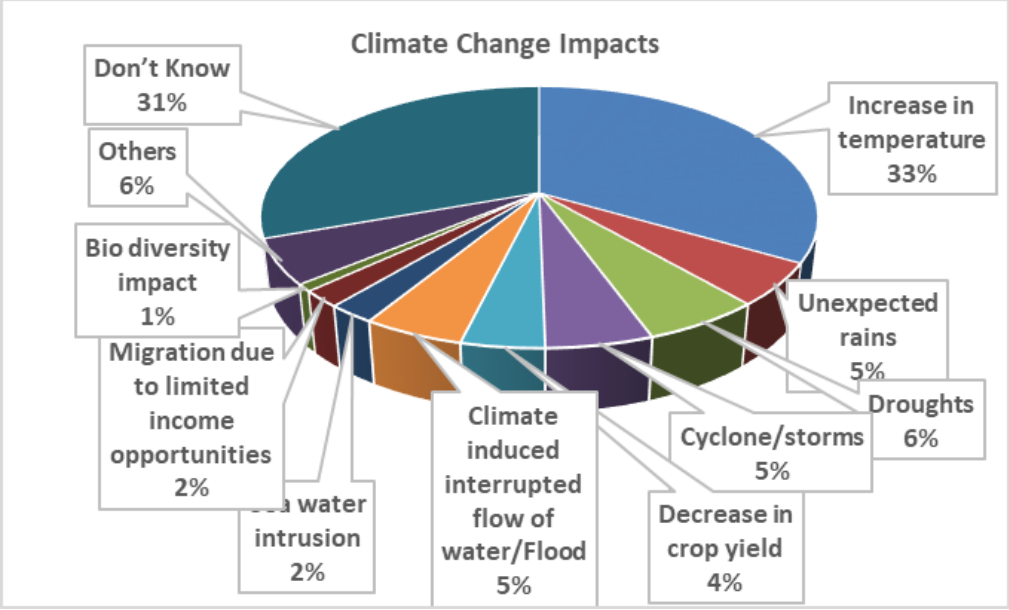


Fig.10. Status of major impact of climate change on the livelihood assets

DISCUSSION

The coastal belt is around 350km. In the recent past, this coastal strip was even more fruitful and fertile than inland areas. On multiple instances unexpected and sudden rainfall patterns in Sindh coastal regions have dramatically impacted the hydrological cycle as well as the coastal morphology throughout recent few decades. Fish stocks have been adversely impacted by climate change, since populations of finfish and shellfish are rapidly declining while those of jellyfish and toxic algal blooms are growing. Significant biodiversity losses and mangrove vegetation destruction. Climate change has negatively affected available resources such as fish stocks as the finfish and shellfish populations are depleting fast, whereas jellyfish and harmful algal blooms are increasing. Great losses of biodiversity and deforestation of mangrove vegetation have also been observed. The LEAD Pakistan indicated three types of migration patterns by changes in environmental patterns and climate change in Pakistan (LEAD, 2016). In the wake of changing climate, the coastal populations in eight talukas (Mirpur Sakro, Ghorabari, Keti Bunder, Kharo chhan, Shah Bunder, Jati, Golarchi and Badin) are living a wretched life as the livelihood resources are being exhausted (DAWN, 2019). In these areas, fishing is the primary source of income for about 70% of the population, with the remainder working in agriculture, cattle, dairy, poultry, and other occupations (Mahar and Solangi, 2017). Aquifers and fertile soils are especially impacted by sea level rise and marine intrusions. Marine level rise and marine intrusion are causing existing freshwater aquifers to become saline and fertile land to either entirely erode or get flooded. Due to the decreased crop output caused by water logging and the lack of other sources of income, farmers are relocating to urban areas. Similarly, the fishermen shift owing to declining fish stocks because of intense and variable weather events. The water flows down the Kotri barrage and the backflow of seawater along the Indus River determines the quality of the water in the area (PDMA, 2012). Water pools with a high salt content were created by the Kotri Barrage downstream of the Indus due to its decreased water output. With salt concentrations ten to twenty times greater than the riverside bed, the once-fertile agricultural area had transformed into barn land. During high tide, the land often receives seawater and turns into mud. Additionally, the upper fertile portion of deltaic areas has been affected by the salt of the subsurface (Amar Guriro,2015). Due to a shortage of fresh

water in the Indus distributaries, red rice, a valuable crop that was grown in the active delta at Kharo Chhan, has been abandoned. Banana, papaya, and guava orchards—crops with significant market value that were formerly grown from the west to the Kharo Chhan region—are virtually nonexistent (Rabani et al., 2008). The decrease in downstream Kotri water discharge is the cause of the sea intrusion (PDMA, 2017). Reduction in downstream water discharge has allowed sea to overwhelm the coastline. Reduced mangrove and sea level rise due to decreased downstream water discharge have hastened the process by permitting erosion and high tide occupation of coastal plains. As a result, seawater currently covers a sizable portion of the districts of Thatta and Badin. Reduction in downstream water discharge has allowed sea to overcome the coastal plains and reduced cover of mangroves, which further has accelerated the process by allowing erosion and high tide occupation of coastal plains. Consequently, a large fertile area of district Thatta and Badin is now under seawater.

LIVELIHOOD OPTIONS

Mangrove forests, fisheries associated with the Indus Delta's wetlands and streams, subsistence farming, village cattle, and fish farming are all closely linked to the livelihood of coastal inhabitants. It is a fact that there is more saltwater intrusion in the lower portions of the Indus River because of the substantial decrease in water flows from Kotri downstream (Mahar, 2018). According to the reports, high levels of environmental degradation, significant losses in agricultural production, a drop in mangrove forests, a loss of inshore fish populations, and drought and freshwater scarcity have all contributed to climate change migration.

MANGROVES AS FODDER

Pakistan's coastline is home to eight different types of mangroves (IUCN, 2019). There are a few *Rhizophora mucronata* plants, and *Ceriops tagal* is found in isolated areas (Rabbani et al, 2008). Other species have been found to be scarce or have disappeared from the delta due to human activities paired with unfavorable physical and environmental conditions. The mangroves are the main source of fodder for camels and other coastal livestock. Silt and clay deposits elevate land and the mangrove plants have limited access to tidal water, the plant growth thus becomes retarded, and the mangrove forest deteriorates.

AGRICULTURE PRACTICE AT COASTAL AREA

Previously several crops such as Wheat, Rice, Banana, Cotton, Paan, Tobacco, Barley, Sugarcane along with a few vegetables and fruits were cultivated along the coastal zone and Indus deltaic area. Now when the 70% of coastal agriculture land is degraded (DAWN, 2006) very few crops are cultivated in the deltaic and riverine areas such as rice and sugarcane in Kharif followed by wheat and vegetables. The agriculture sector of the coastal area is shrinking at alarming stage. It is needed to develop new concept of coastal agriculture with an objective to use saline waters or salt resistance crops.

LIVESTOCK DAIRY AT COASTAL AREA

In Sindh's coastal region, the cattle industry is third in importance. The animals are used for dairy, meat, and transportation. The demand for beef and mutton is rising on a local, regional, and global scale since they are fundamental sources of protein. However, cattle husbandry is severely impacted by the effects of climate change, freshwater scarcity, and droughts (Mahar, 2018). The Sindh government has created a dairy village and meat processing zone in Bhambore, Thatta, considering the current reforms. A livestock and fodder market, feed mills, chilling units, and slaughterhouses with meat processing facilities are also part of the project's plans.

FISHERIES SECTOR OF THE AREA

About 40% of the coastal community's income comes from fishing (DAWN, 2014). Shrimpers are exploited, shrimp rapped, shrimp, shrimp. A coastal area survey report (Mahar, 2016) states that 28 commercial marine fish species have been

found in Sindh coastal streams. There are three species. There are three species. These live crabs are delivered to the market. The edible oyster, green mussel, and razor clam are exported in live form and have significant economic significance. The effects of climate change have caused a higher decline in fishery resources during the past few decades.

POULTRY FARMING STATUS IN SECTOR

The study's coastal area is roughly 20. Although wind and environment are excellent for poultry production, freshwater supply is key challenge of the region. The growth and survival of small-sized chickens were particularly impacted by the coastal area's warmth and humidity. Sea sites are not excellent for poultry farming, but agriculture and rich land enhance the growth rate of farmed chicken. Keeping in view of above factors, it has been revealed that climate change is a real factor that can impact on the living and non-living resources at coastal zone of Sindh especially at both the districts.

Table 2. Proposed action plan of livelihood options to formulate the policy/strategy

S. No	Proposed measures		Action taken
1. Water and general issues and provisions for sustainable development			
i.	Freshwater shortage at lower riparian and gradual onset of disasters (droughts, sea level rises, coastal erosion, sea intrusions, erratic rains, cyclones and floods).	Maintained with coordination	Federal, Provincial, and District Governments, EPA, NDMA, PDMA, Sindh Coastal Development Authority, Research Institutes, Universities, Donor Agencies, NGOs
ii.	Formulation of soft loaning systems, policies, special financial packages, scholarships and income support programs for climate affected people.	It could be done and a good possible step.	Banks and other investing agencies, Sindh Small Industries Federal/ Provincial, Federal, and District Governments, any Donor Agencies/ NGO.
iii.	Establishment of technical training centers, vocational diploma or degree certificate awarding schools and centers for production of male and female trained human resource	This is a possible measure that can be taken as soon as possible.	Government, NGO, Academia or any private forum take step for this.
iv.	Provision of machinery, seed, feed, gears and crafts, machinery or livestock incentives to vulnerable coastal communities in case of disasters or need cum merit basis.		Federal, Provincial, and District governments/ NDMA/ PDMA/ DDMA, Donor Agencies, INGO, and NGOs
2. Forest and wildlife incentives as support for livelihood			
i.	Mangrove and other forest herbs and Serbs and wild trees are spawning habitats, shelters and nesting places for wild animals, birds and honeybee. They provide fodder for animals, wood for furniture and match sticks.		Currently with support of World Bank projects the federal and provincial government, especially Sindh Forest department and WWF are propagating and enhancing the forest ecosystems and mangrove

		plantations at coastal zone of Sindh near Keti Bandar and Shah Bandar talukas.
3. Agriculture		
i	To promotion the local varieties of seeds, vegetables, fruits and crops in agriculture field that can be grown and propagate in saline land at high temperature ranges.	Through public and Private partnerships. Government, academia and any organization. Agriculture department plays vital role in this matter.
ii	To introduce the exotic variety of any seed of rice, wheat, barley, grain, peas, corn, etc. In vegetables like potatoes or any saline water fast growing environment friendly variety of vegetables, fruit or crops in agriculture sector.	Federal and Provincial Government, academia and any other organizations take part in this matter with special coordination with agriculture department.
iii	The developed countries such as China, Turkey and Egypt successfully experimented on the salt tolerant varieties of potatoes, banana, rice, wheat, barley etc.	Federal and Provincial Government, academia and any other organizations take part in this matter.
iv	Awareness and capacity building through training for alternative skill development, diversification in crop pattern.	Federal, Provincial, and District Governments, NDMA, PDMA, Sindh Coastal Development Authority, Livestock and fisheries department, Universities, Donor Agencies, NGO
4. Adaptation of climate in Livestock sector		
i.	Livestock farming of local varieties of animals such as camels, cows, goats, sheep, rabbits, are suitable for meat production at local levels. Currently some of exporters are exporting meat from Pakistan to other countries	Federal and provincial governments, Sindh Coastal Development Authority, Donor Agencies and NGOs play role in supporting the communities in cattle farming.
ii.	Dairy milk production has been major component in rural areas for a long time. Still its importance and value are same. Some measures may be taken for enhancement of dairy Milk, Butter and Dahee etc.	Small loans and incentives may be given to coastal community for cattle farming federal and provincial government and supporting organizations take steps for enhancements.
5. Poultry and birds farming		
i.	Chicken farming is common trend at Coastal zone. The turkey hen bird is also fast growing, it also recommended for culture.	The small loans and incentives may be given to coastal community for chicken farming and its cages along with seed feed and water.
ii.	Framings of Batair or partridges or Teetars are now started at coastal zone. Its small chick rate is Rs.20-30/- after 2-3 months farming, they reached at adult stage and become200 -300 gram with reasonable rates.	The small loans and incentives may be given to coastal community for Batair farming and its cages along with seed feed and water.

iii.	Ostrich culture is useful for culture at proposed union councils of coastal zone.	The government and organizations may support the start the farming mechanism.
6. Fisheries sector		
i.	Saline finfish farming is best incentive. Tilapia fish are hardy that can survive in saline waters, and the high temperature range near to 38°C. African catfish is second option of hard fish that can survive at low oxygen levels. Also, a type of hard fish survives in normal saline water near to 5ppt and at 38°C. Nowadays these fish species are available in Pakistan and easily grow in ponds and waterlogged areas. Sea bass and sea bream fish can be cultured in saline water ponds and creeks through cage culture systems.	The Sindh Fisheries Department should make joint ventures. The initiatives may be carried out through public private partnership. Pilot based breeding; spawning and farming may be started at government fish farms and hatcheries in coordination with NGOs and the community.
ii.	Shrimp farming is also a better option. Sindh Fisheries Department at Hawksbay fish hatchery produced millions of shrimp juveniles each year during breeding season. They collect berried female and ripe male shrimps for breeding and spawning artificially.	The small loans and incentives may be given to coastal community for shrimp farming and its cages along with seed, feed and nets.
iii.	Crab fattening is common culture system at coastal zone in Sindh. Farmers are catching small crabs from mangrove mates and holds in small cages and ponds. They artificially feed small fish twice a day for period of 1-2 months. When crab reaches 300-500 grams. They sale out at good prices. Crab farming system is not common in coastal areas. Therefore, it needs popularization.	The government and any organizations may support starting the farming mechanism in collaboration and coordination with Sindh fisheries, community and supporting organization.

ACKNOWLEDGEMENT: Present study carried out with the financial assistance and support of marine research projects funded by Petroleum marine development Thatta and Petroleum Marine Development Committee Sujawal. Project Title: Establishment of Oceanographic Survey Unit: Climate Change, Freshwater Scarcity and Pollution Impact Assessment on Geomorphology, Mangrove, Fisheries and Wildlife Occurring in Coastal and Marine Waters of District Thatta". "Establishment of Marine Research Laboratory and Survey Unit: Population Dynamics, Pollution Impact Assessments, and Way-Forward of Coastal and Marine Biodiversity in Creeks of Sujawal Sindh Pakistan". Therefore, the Chairman, Secretary and members of PMDC Thatta and PMDC Sujawal are highly acknowledged in this connection. The authors are offering gratitude to Mr. Abdul Hadi, Advocate Sarmad Iqbal and Mr. Bashir Ahmed Wasim for helping in analyzing the results.

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