

DESIGNING STRATEGIES TO MITIGATE THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN KUTCH, GUJARAT



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Executive Summary

The process of climate change takes slowly over a long period of time. This makes the people complacent. Gradually climate change has been impacting walks of our life from the way we live, the food we eat, the clothes we wear and the travel that we do. Climate change is related with change in frequency, intensity, duration of the precipitation pattern and the change in atmospheric temperature and humidity. In India, since most of the agriculture is dependent on rain, with the change in temperature and precipitation, the impact on agriculture is going to be significant.

The focus of the study is to develop a deeper understanding on the impact of climate change on agriculture in general and Rapar area of Kutch in particular. The recommendation of the study can be used by the practitioners working in the field of agriculture to plan and implement their program.

There are some limitations to the study especially related with the diversity of the data used. Most of the data which has been collected and collated has been obtained from the Department of Agriculture, Government of Gujarat. Although the diversity and triangulation of data enhances the quality and authenticity of the study but due to lack of credible information, this could not be carried out in details.

Acknowledgements

I express my sincere gratitude to the countless farmers of Kutch who are the main protagonists of this study. For around two months during the field visit, they extended all the possible support in spite of it being a peak agriculture season. Thanks to all the farmers for sharing their insights on their agriculture practices and the challenges associated with it. I would like to thank the Women Farmer's group who are yet not formally recognized as the farmers but plays a very critical role in the farming sector.

My special thanks to Cohesion Foundation Trust and its team led by Mr. Rajesh Kapoor and Bhanu Bhai Mistry for giving very valuable insights into the issues related with farming. I must say that Mr. Kapoor has a huge understanding on various development issues and the context. The Cohesion Foundation Trust team comprising of Kalyan Dangar, Patu Bhai Ahir and the frontline workers were ever ready to help me during my studies.

This study is a part of Internship under the MA In Humanitarian Action being undertaken by me with University of Groningen, The Netherlands as my home university. My sincere thanks to my supervisor Elena, the faculty members and my batch mates for constantly guiding me throughout the study.

I am very grateful to the various line departments and key stakeholders associated with agriculture in Gujarat and Kutch in particular. Many thanks to The Department of Agriculture, Government of Gujarat, The Dantiwara Research Institute, The Shroff Foundation, Sajeev Kheti Manch, The Agrocel Industries Limited for providing me with the valuable insights and data related with agriculture. I am also indebted to various business community operating at various scales by providing agriculture inputs to the farmers. Their perspective on agriculture trend in Kutch was very valuable in understanding how the farmers take decisions in terms of crop and other agriculture inputs.

My heartiest gratitude to my entire family: Afroz, Shayaan and Adiba for letting me with some free time in India. They truly deserved my attention but thanks to them being very understanding while writing the report.

About the Organization

Cohesion Foundation Trust is a registered NGO founded in 1996. The organization stands on the principles and philosophy of a group of professionals with a genuine interest in integrated human progress and firsthand experience in diverse facets of social development, got together and created a platform for action and awareness. We started as a support organization and slowly diversified our efforts towards having direct presence in the disadvantaged areas of Gujarat. Providing support on various aspects of development still remains one of our core competences.

In the last thirteen years of its foundation, Cohesion has grown as a grassroots organization striving for a holistic development. Our initial direct intervention was responding to the devastating earthquake in Jan 2001. We responded by deploying manpower and resources in the most affected districts. Since then the efforts have been consistent but the focus kept changing depending upon the need of the area.

Today, Cohesion Foundation Trust has an established presence in seven districts of Gujarat – Kachchh, Rajkot, Patan, Navsari, Vadodara, Tapi and Banaskantha. Expansion to other states has started with initial focus on Rajasthan, Chattisgarh and Uttarakhand. Cohesion has professionals from all spheres of the development sector. Our capacity over past few years has increased tremendously in handling large projects on larger areas.

Cohesion, adopts a holistic development process, which is directed towards the overall quality of life of the community. With this as guiding ideology, Cohesion has made immense efforts in addressing the challenges associated with livelihood of the communities, enhancing the accessibility of the people to resources and ensuring that issues of the community gets more visibility so as to bring about pro-poor changes in policies and procedures. The programmes undertaken are also directed towards addressing the challenges of the communities at all spheres and covered issues such as Natural Resources Management (NRM) and agriculture, on-farm livelihood, livestock management, education, health, disaster preparedness, decentralized governance, micro-finance and off-farm livelihood activities.

There are certain cross cutting themes, observed in all strategic interventions to ensure sustainable development and social justice. The approach is community based and bottom-up to ensure the needs and issues faced by communities get represented and addressed by programs. Strengthening people's institutions and prioritizing women's'

role in decision-making ensure processes that help in mainstreaming gender. On the other hand, most vulnerable communities are identified at micro planning stage to empower them and help secure proper position in community-based institutions.

The core values of our programmes are: **Social Equity, Inclusive processes, Gender equity, Sustainability, and Empowerment.**

Objective of the study

COHESION Foundation Trust is in the process of designing a proposal for UNDP through CEE on the impact of climate change on agriculture. Through this study, the organization wants to understand the following:

- How the farming community in the proposed area constructs and deconstructs the impact of climate change?
- Has there been any significant change in rainfall, temperature, salinity intrusion and wind speed & direction in the last 20-30 years in the proposed area?
- Has there been a change in the cropping pattern in the last 20-30 years?
- How are the farmers addressing or adapting to the above changes?
- How are the government policies and programs adapting to the above changes and how the scientific community are addressing those?

Methodology Selected

The study was carried out over a period of four months and focuses on both the primary as well as secondary information. The study was divided into various phases focusing on interaction with Cohesion Team Members, designing of the objective, tools and methodologies of the study, testing of the study design in the field, primary data collection from various stakeholders, data interpretation & report writing and fine tuning the report based on feedbacks from key stakeholders.

Secondary Data

The process of secondary data collection and analysis started from interaction with the Cohesion Foundation Trust Team members working on agriculture and climate change. The discussion focused on mandate of the study and key actors associated with it. This was followed by web based secondary research focusing on the following:

- How the impact of climate change is constructed and deconstructed at various levels.
- Agriculture systems, patterns and schemes being followed in this region
- What kind of work has already been done by different institutions on these issues?
- What are the various government departments and institutions directly or indirectly involved with similar work

Primary Data

The collection of primary data was done through direct interaction with some of the key stakeholders. The key stakeholders were decided based on secondary research. At the community level, the data was collected through *Focus Group Discussion* while at the institution level this was done mainly through personal interviews. Some of the formal/informal institutions and organizations that were administered the questionnaire are as follows:

1. Mixed farmers groups (comprising of both male and female from the community).
2. Women's groups who are involved in agriculture activities.
3. Farmers Co-operatives involved in supply chain management and financial.
4. Milk co-operatives involved in procurement of the milk from the community and selling it to big companies like National Dairy Development Board (NDDB) and Kutch Dairy involved in processing, packaging and marketing.
5. Progressive farmers from within the community who are mostly the innovators and early adaptors to any new ideas, technologies and crop varieties
6. Agriculture input supplier at the local as well as district level.
7. Government department like the department of meteorology, department of agriculture, department of animal husbandry, Zilla Panchayat (the governance structure at the district level).
8. Research institutions supporting the government on experimentation, innovation and dissemination like Dantiwada Krishi Vigyan Kendra, Gujarat Institute of Desert Ecology (GUIDE), Central Arid Zone Research Institutes (CAZRI).

9. Community whose livelihoods and to a great extent dependent on Animal Husbandry (the Rabari's)
10. Individuals belonging to various institutions or working individually on issues related with agriculture and animal husbandry

Note: Please see the questionnaire as the attachment

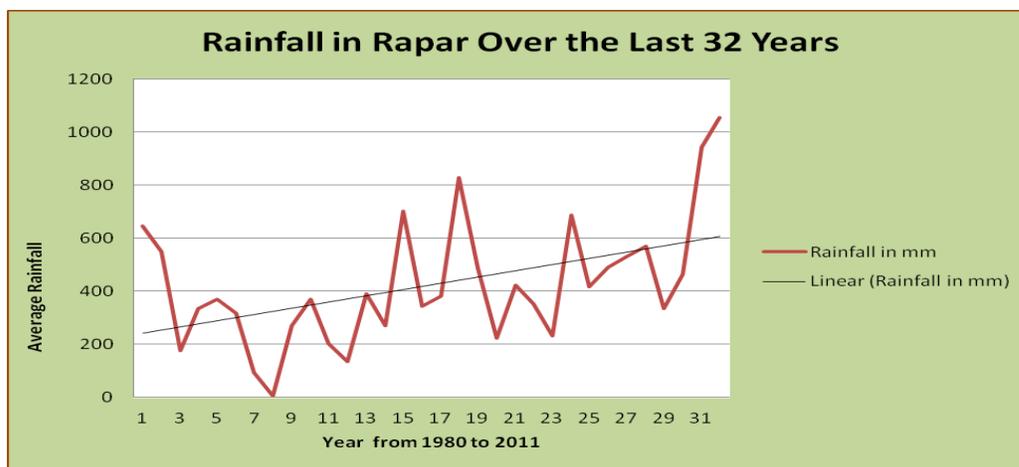
In what ways climate change is impacting the local weather conditions during the last 30 years?

Over the decades, there has been overall improvement in the overall precipitation in the area. According to Indian Express (May22, 2011), due to the impact of climate change, the Kutch district is becoming wetter with increased precipitation.

According to Mr. Devi Dayal, CAZRI (based on personal interaction), in order to study climate change and its impact in a particular area, the weather pattern for atleast the last 30 years should be taken into consideration. There is only one agency, IMD (Pune) which provides the data officially and the data can be requested and bought from them.

What has been the pattern of precipitation, heat and salinity in the above mentioned period?

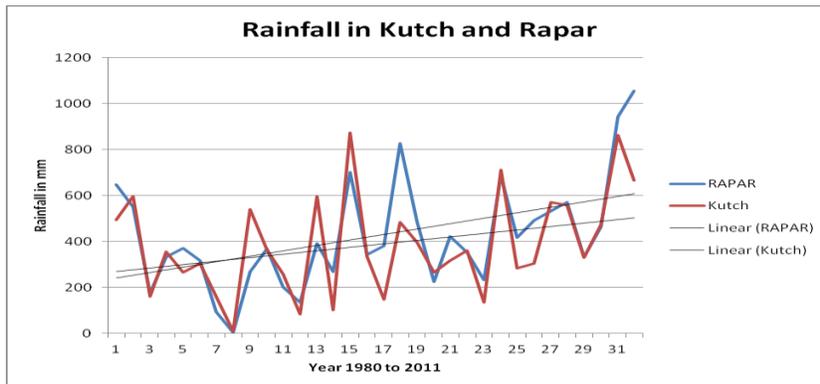
The impact of climate change has led to higher rainfall in Kutch which in turn has led to growing livestock and other crops previously unseen in this region. There has been a decrease in drought since 1990 which has led to an increase in the net sown area by 14% between 2003 and 2008 (Indian Express; May 22, 2011)¹.



Source: Zilla Panchayat, Kutch

¹ <http://www.indianexpress.com/news/arid-kutch-getting-wetter-crop-cover-livestock-on-a-rise/793872/>

Looking at the data above, it is very explicit that the average rainfall in Rapar during the last 30 years has increased three fold from 200 mm to around 600 mm. The utility of the

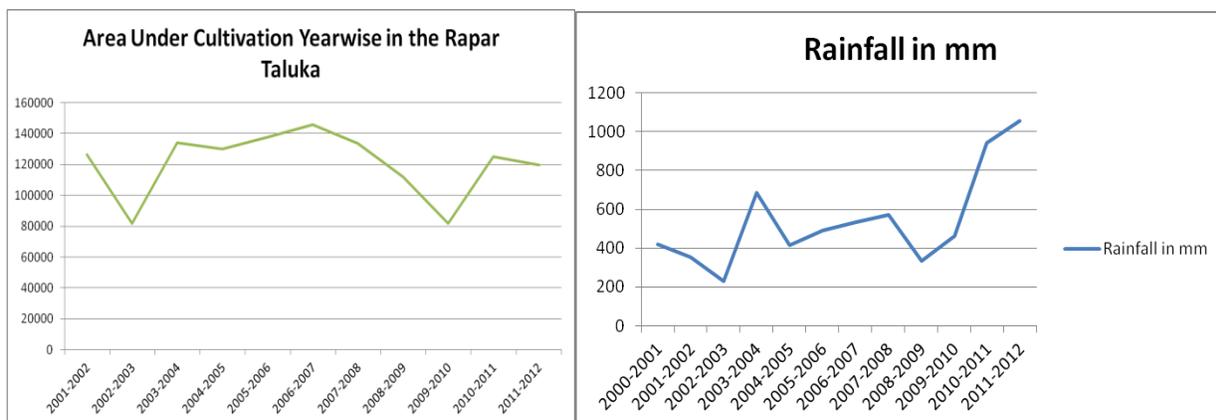


rainfall on the growth of the crop is not only dependent on the quantity of the rainfall and the duration of the rainfall. It has been observed in discussion with the community, that the quantity of rainfall has increased but at the same time number of rainy days

has decreased. The impact of the rainfall pattern needs to be explored in details.

Has there been a shift in the cropping pattern in terms of crop type, crop variety and crop cycle?

The variation in rainfall shown in the graph above could be one of the major implications of climate change. The kharif crop in this area is mostly dependent on rain and variations in rainfall could have a major effect on the total net sown area.

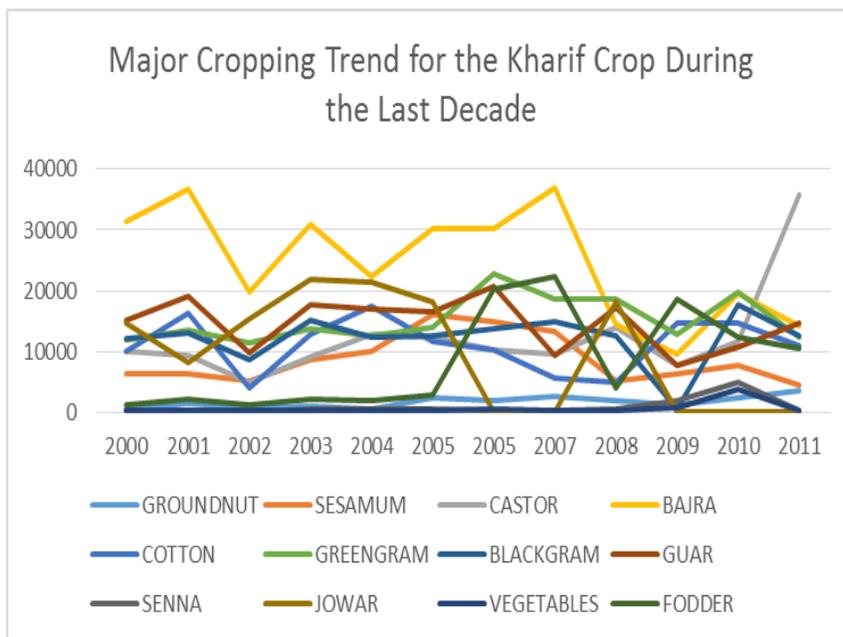


The graph above shows the net area sown in different years starting the year 2000. It could be inferred from the graph that the net sown area varies between 80,000 acres to 1,40,000 acres with the variation being around 80%.

The graph below shows that rainfall which is a factor of weather conditions plays a very critical role in the amount of net sown area. Comparing both the graphs above, it cannot be inferred that more rainfall in a season leads to increase in the cropping area and less rainfall leading to drop in the cropping area in a particular year.

Based on the discussion with the farmers and the input supplier, there has been a gradual shift by the farmers in terms of preference of seeds. Now more and more farmers are moving towards the hybrid seeds from the traditional seeds. Around a decade back, the input supplier used to sell the hybrid and the local seeds in the ratio 20:80 which has reversed during the last one decade. The reversal in the preference of seeds are being attributed to more rainfall in the area during the last decade.

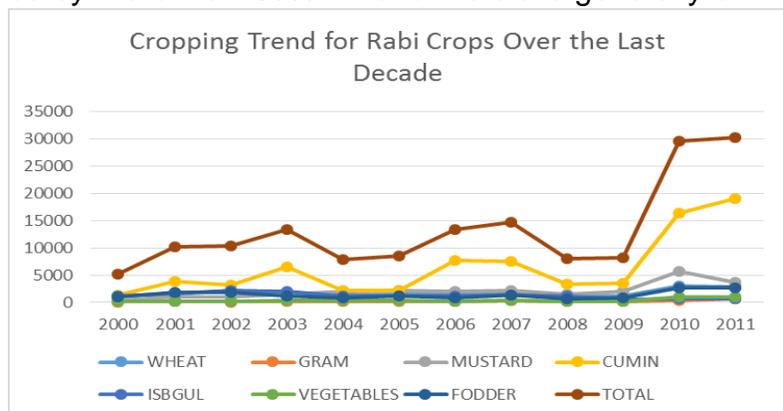
What are the major crops grown by the farmer at present? What kind of a perceived trend is visible in terms of change in cropping pattern over the next 10 years?



The following table showing the major cropping trend for the Kharif crop during the last decade has been taken from the Department of Agriculture, Government of Gujarat. From the table it can be deduced that castor has been one of the most preferred crop and the areas under cultivation has increased more than three and a half times. The reason, the farmers attribute to

this is the growing market for the same. The crop which has shown a drastic decline are Jowar and Bajra to some extent. The area under Jowar has become almost negligible while under the Bajra has reduced by more than 60%. The farmers are generally of the

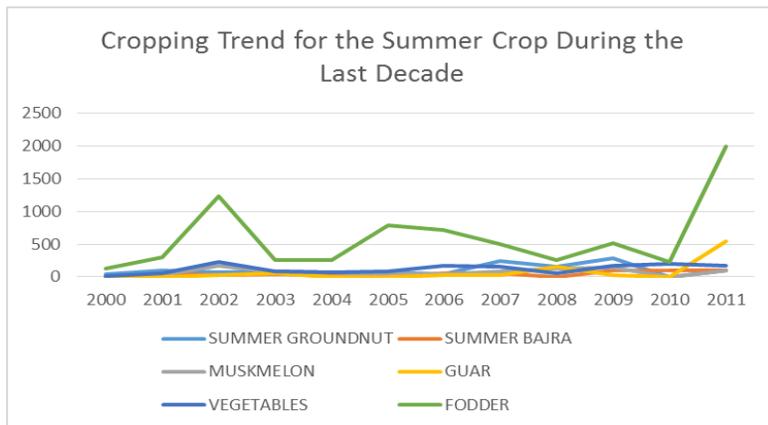
opinion that Bajra which is used for personal consumption can be procured from the market if they are able to make good money from the cash crop. There has also been a change in the preference for the staple food for the local community, they are preferring wheat over Bajra for personal consumption. Jowar, which is mostly used for fodder has become



negligible because the farmers of late are procuring the fodder from the market or are using other crops as fodder crops.

As far as the Rabi crops are concerned, there is around six times increase in the area under cultivation. This could be attributed to strengthening of overall irrigation systems in the area. The farmer also attribute this to the increase in rainfall and the capacity of the farmer to store the water for Rabi crops. The Government of Gujarat has been proactive over the years and is promoting small, community level water harvesting structure across the region.

The major Rabi crops grown by the farmers are cumin, mustard, wheat and fodder with



cumin grown in more than 60% of the net sown area. The area under cumin has increased more than fifteen times during the last decade. It is also worthwhile to mention that the farmers has also started taking vegetables which is mainly meant for the market. There has also been a remarked improvement in the dairy sector

with well-established cold chains after 2004-05. This has also led to drastic increase in the production of fodder during the Rabi season also.

As far as the summer crops are concerned, the net sown area is almost negligible with around 3000 acres for the year 2011. The summer crop is totally dominated by fodder being grown in more than 2000 acres. There are some

other crops like groundnut, vegetable, musk melon which the community grows on a very small scale.



Promotion of water harvesting structures has led to the drastic increase in Rabi and Summer Crop

Who should be the target community for COHESION Foundation Trust for the proposed interventions?

According to the Nation Policy for Farmers, 2007, “a FARMER is a person actively engaged in the engaged in the economic and/or livelihood activity of growing crops and producing other primary agriculture commodities and will include all agricultural operational holders, cultivators, agricultural laborers, share croppers, tenants, poultry & livestock rearers, fishers, beekeepers, gardeners, pastoralists, non-corporate planters and planting laborers as well as persons engaged in various farming related occupations such as sericulture, vermin-culture and agro-forestry. The term also includes tribal families/ persons engaged in shifting cultivation and in the collection, sale and use of minor and non-timber forest produce.

The government of India has divided the farmers into various categories based on the land available to them. The definitions are as follows:

S No	Type of farmer	Amount of landholding in acres
1	Marginal	0 - 2.5
2	Small	2.5 – 5
3	Medium	5 – 10
4	Big	Above 10



Working with small and marginal farmers especially women has been the focus of Cohesion Foundation Trust

Cohesion Foundation Trust define farmer as any male or female, landowning or landless who is involved in agriculture practices.

The local community defines different types of farmer in a different way. They also feel that anybody and everybody who is involved in agriculture is a farmer irrespective of whether they have the land ownership or whether

they are male or female.

What should be the target geographical location for the project and rationale for the same?

COHESION has been working with the farmers both in Adesar and Rapar. One of the objectives of the study is to select the geographical areas along with the villages based on certain rationale. As per the interaction with COHESION team members, selected of villages in Adesar has certain advantages which are as follows:

1. Strong community mobilization process in the area with different stakeholders especially with the community.
2. Past experience of implementing agriculture based project with the farmers in Adesar.
3. Presence of an education project with the community which has reinforced the community mobilization process
4. COHESION has better understating on issues related with farmers in Adesar.

Within Adesar, there are certain villages where Cohesion Foundation Trust has a very strong presence in the community. This has been built over a period decade when Cohesion started intervening in these areas after the Bhuj Earthquake in 2001. At present, Cohesion has a strong program on education in these areas and through this program they have further strengthened their presence in the area. The ten villages selected for intervention, based on the interaction with Cohesion head office and field team are as follows:

S No	Name of the village	Target Community
1	Sukhpar	Rabari and Kohli
2	Varnu	Maharaj, Kohli, Bharwar
3	Lakhagarh	Ahir
4	Phulpargaon	Ahir and Kohli
5	Naagtar	Kohli
6	Sanva	Ahir, Rabari, Maali
7	Moda	Patel and Rabari

8	Khandek	Maharaj, Rabari, Harijan
9	Manjuvaas	Kohli, Ahir
10	Momaimora	Kohli, Rabari, Ahir, Maharaj

Please note: This is a tentative list of villages based on the interaction with Cohesion team members and study carried out in the field and it is subject to change based on the interventions approved by the donors. These are the villages where the livelihood of the community is dependent on agriculture as well as animal husbandry. It is proposed that the organizations should not be working with all the community but the community should be selected based on the mandate of the organization as well as the project.

What has been the impact of climate change on Animal Husbandry and perceived trends for the next decade?

1. Difference in perception of male and female farmers vis. a vis. selection of crops
2. According to separate *Focus Group Discussion* conducted with the female farmers in three villages with a diverse set of community, both male and female farmers are involved in decision making process in terms of crop selection and the areas to be earmarked for growing different types of crops. Sometimes it is the male members who take the last call if there is some confusion regarding the same.
3. Building the consensus between male and female farmers
4. Suggest 5 crops to be taken up for intervention

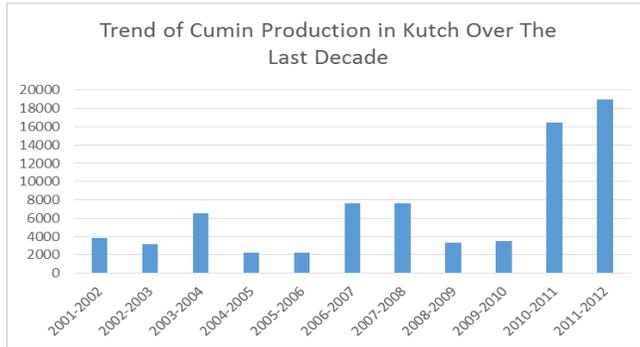
Cohesion foundation trust should be promoting an agriculture and animal husbandry practice which is environmentally sustainable, economically viable and socially acceptable. There has been a gradual shift in the agriculture production in the region where the farmer has been shifting gradually to cash crop from the food crop. This can be attributed to the exposure of the local farmer to outside market. There has been emergence of various agriculture, micro-finance and dairy related co-operative societies in the area.

Major crops proposed for interventions are as follows:

- Mixed cropping taken up by the farmers during the monsoon season
- Cluster Beans (locally known as Guar)

- Fodder for all the three seasons (Kharif, Rabi and Summer)
- Cumin Seeds (Kharif)
- Eranda or Castor

Justification for selection of the above mentioned crops

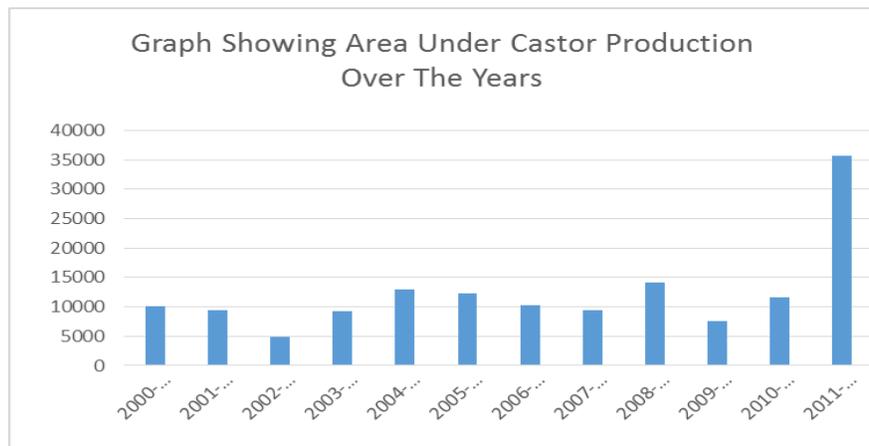


Cumin Seeds: India is the largest producer and consumer of cumin seeds contributing around 75% to the global production. Gujarat is the largest producer of cumin seeds in India². During the last few years the production of cumin has increased by three times in Gujarat with the total production being

11.3 lakh quintals in 2013. One of the reasons attributed to it is the increase in export by at least 20% as there has been its enhanced utilization in the perfume industry³.

As per the discussion with the community in various villages, the winter season is becoming colder which is conducive for cumin seeds. Please note that there is no empirical data or evidence to substantiate that the coldness and its duration is increasing during the winter season. The inference is based on the discussion with the community. This needs to be verified with the data from Indian Meteorological Department.

Castor or Eranda: Castor (ricinus communis) is an important non-edible oil seed crop grown especially in arid and semi-arid areas. The oil extracted from castor has widespread applications in various industries like paint,



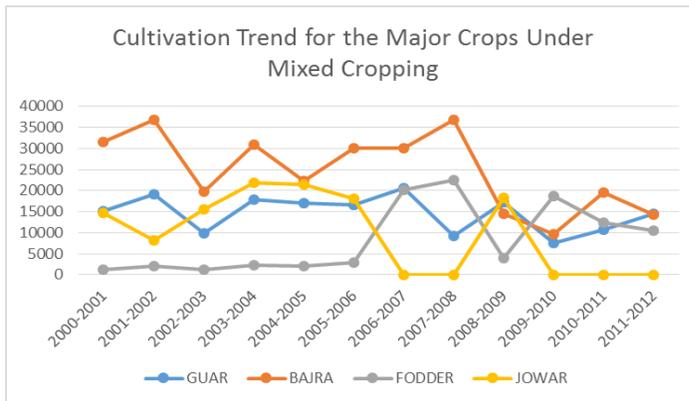
² <http://122.170.3.177:9090/napmc/products/cumin.aspx>

³ http://articles.timesofindia.indiatimes.com/2013-10-09/ahmedabad/42861488_1_cumin-jeera-apmc

lubricant, pharmaceutical, textile etc.⁴. India is the first in the castor bean production in the world where it is grown in 73,000 ha with the annual production of around 7,30,000 MT with the average yield per ha being 1210 kg⁵. It is one of the preferred crop among the farmers in Kutch as it is appropriately suited for the local climatic conditions and gives high return also. From the graph above it can be deduced that there has been around four times increase in the castor production area in Kutch over the last decade.

Mixed Cropping

Mixed cropping is an agriculture system wherein different crops are sown in the same field for various reasons like maintaining the soil fertility and reducing the impact of climatic conditions. It has been very popular in areas which suffer from unpredictable climatic conditions and rainfall. Mixed cropping also controls the growth of weeds to a certain extent⁶. This has been very popular



in Kutch since time immemorial. The crops for mixed cropping are chosen in such a way so that there is optimal competition between various crops for nutritional intake from the soil as well as space available for growth.

From the graph above, we can make some very references. There has been drastic decline in the cropping of Jowar over the last decade. While talking to the farmers, it was inferred that now the focus of majority of the farmers is the cash crop and they depend on the market for the



Mixed Cropping has been one of the time tested ways through which the farmers overcome the vagaries of nature

⁴ <https://www.itisil.com/Admin/Research/602.pdf>

⁵ http://www.crida.in/Climate%20change/PSE%2054_38-46-Castor.pdf

⁶ <http://www.meritnation.com/ask-answer/question/what-are-advantaes-and-disadvantages-of-mixed-cropping/improvement-in-food-resources/2211613>

fodder and for personal consumption. However, some of the farmers from the poor community emphasized that they would still cultivate some Bajra which takes care of their immediate food security. While the cultivation of Bajra has declined over the decade but the change has not been drastic.

Various crops that are taken as mixed crops in Kutch are Mug, Muth, Bajri, Jowar and Til. Some of the crops out of these like Bajri, Jowar and Mug grow and yield when there is sufficient rainfall otherwise crops which require less moisture like Mug, Jowar (for the cattle feed) and Til prosper in case of scant rainfall. The mixed crop has traditionally evolved in such a way that it takes care of the food security (Bajri), cash needs (Til) and fodder (Jowar) needs of the community.

Climatic Conditions for Mixed Crops

Bajra: Bajra crop survives under adverse climatic conditions. It is grown in low rainfall regions, with annual rainfall ranging from 50-70 centimeters. It is a drought tolerant crop and is suitable for dry farming situations. Moist weather is conducive to growth during its early vegetative period. A temperature range of 20-30°C is best for its growth⁷.

Jowar: Sorghum can be grown under a wide range of climatic conditions although ideally it requires warm climate. It is grown from sea level to as high as 1500 meters. Sorghum plants can tolerate high temperatures throughout their life cycle better than any other cereal crop. It can tolerate drought conditions very well because it remains



dormant during moisture stress conditions but resumes growth when favorable conditions reappear. It has a high resistance to desiccation, low transpiration ratio and a large number of fibrous roots. It can also tolerate water logging conditions better than any other cereal except

rice. Therefore, sorghum can be grown successfully in areas having an average annual rainfall between 60 and 100 cm. It is grown as a Kharif crop in northern India. In western and southern parts of the country it is grown also as a Rabi crop. The minimum temperature for the germination of sorghum seeds is 7-10 Degree Celsius. It needs about 26-30 Degree Celsius temperature for its optimum growth. Sorghum is a short day plant. Flowering is hastened by short days and delayed by long days. The time of

⁷ [www.inseda.org/...%20Millets%20Production%20\(CMPS\)/Bajra-097.doc](http://www.inseda.org/...%20Millets%20Production%20(CMPS)/Bajra-097.doc)

heading in sorghum is influenced by temperature as well as photo-period. Sorghum varieties vary in their sensitivity to both temperature and photo-period⁸.

Til: Sesame is basically a crop of the warm regions of the tropics and subtropics and grows in the plains and at elevations up to 1,200 m. A temperature of 25-27°C encourages rapid germination, initial growth and flower formation. Low temperatures at flowering can result in the production of sterile pollen, or pre-mature flower drop. Sesame is extremely susceptible to water logging and heavy continuous rains. Sesame is susceptible to hail damage at all stages of growth. It can also not stand frost, continued heavy rain or prolonged drought. The proper time for planting of sesame under northern Indian conditions is last week of June to first week of July. A range of 25-27 Degree Celsius temperature is suitable for its proper germination. In South India sowing time during *Kharif* season may vary from May to July and for Rabi season from October to November⁹.

Cluster Beans: Cluster bean is essentially a warm season crop and grows well in summer as well as rainy season crop. It is very hardy crop and relatively resistant to drought¹⁰.

There are three different types of cropping pattern adopted by the farmers to reduce the impact of adverse weather conditions.

Interface with Other Agencies

There are various agencies working directly or indirectly with the farmers on agriculture and animal husbandry issues. Some of the suggested interface are as follows:

- SETU: Setu is a community based institution created by a local NGO “*Kutch Nav Nirman Abhiyan*” to enhance the interface between community and other institutions so that the community has better access to information and services provided by various institutions. They are also into transferring the technical know-how from lab to land. Based on the emerging demand from the market Setu has formed an association of farmers who are into “*Self Certified*” organic products. Now most of the farmers are also in the possession of certificate for organic farming. It is proposed that some of the farmers, based on certain criteria, who are willing to be certified as organic farmers, should be provided

⁸ <http://www.pnbkrishi.com/jowar.htm>

⁹ <http://www.pnbkrishi.com/sesame.htm>

¹⁰ <http://agriinfo.in/?page=topic&superid=1&topicid=91>

with the opportunity for the same. There should be some kind of a formal tie-up between Cohesion Foundation Trust and Setu promoting organic farming and its marketing.

- Dantiwada Agriculture Research Institute: It is an agriculture research institute involved in testing new technologies, crops and dissemination of the same. The nearest research institute is in Bhachau. There has been several types of innovation in the agriculture sector in the area. The institute is also trying new cash crops like Olive with technical collaboration from Israel.



Research Institutions are experimenting with new cash crops like Olive

- Gene Campaign: It is a non-profit organization working on food and livelihood security of the poor. Its main focus of work in Kutch region has been farmers & community rights, regulations of GMO and impact of climate change on agriculture. The organization is conducting a series of awareness campaign to raise the awareness level of the farmers on GMO and climate change & agriculture.¹¹
- Shroff Foundation: Shroff Foundation through Agro-Cell Industries Limited is closely working with the farmers all across the Gujarat on agriculture related interventions. It is an agency which provides inputs to the farmers right from seeds, fertilizers, pesticides to technical inputs to enhance crop production. It has got a huge network of stores all across Kutch. During the recent years, the focus of Agrocel Industries has also been on organic farming. The network of Agrocel could be used to enhance the outreach of the program.¹²
- Co-operative Societies at the Community Level: Kutch has an enhanced reputation of being the land of co-operative societies. These co-operative societies are involved in various activities related with the livelihoods and the enterprise of the community. Three types of prominent societies could be witnessed during the field visit, one focusing on milk & dairy wherein the role of

¹¹ <http://www.genecampaign.org/>

¹² <http://www.agrocel.co.in/new/index.html>

the co-operative society was to strengthen the cold chain. Other form of co-operative society was involved in giving loans to the community for a particular purpose. The community takes the loan from the society mainly for agriculture purpose for buying agriculture inputs. The third type of society focuses on collective buying of agriculture inputs on behalf of the members of the society. It is very crucial to work with the community based co-operative societies for community mobilization and other project interventions.

Recommendation

- Promotion of traditional cropping systems like mixed cropping, inter cropping and relay cropping.
- Focus in agriculture extension where in the technology in the lab is brought to the land. There are several agencies both government and non-government which is working on research and extension of agriculture services. Some of the NGO's specifically focus on the small and marginalized farmers.
- Strengthening of the existing institutions like the *Dairy Co-operatives, Farmers Co-operatives etc.* Gujarat has a strong culture of co-operatives.
- Focus on progressive farmers as an agent of change. A strong interface needs to be developed between progressive farmers and small & marginal farmers. The progressive farmers as has been witnessed in the field have the ability and resources to do innovations.
- Strong institutional linkage between the farmers, the government and other institutions of change.
- Focus on local level traditional water harvesting structure and water use efficiency. The Government of Gujarat has several subsidized schemes to renovate and build new small scale water harvesting structures.
- Promotion of water conservation measures like mulching, drip irrigation and sprinklers.
- Promotion of rain fed organic farming and exploring the marketing of organic farm produce in close collaboration with SETU Adesar
- Follow up study on the impact of Narmada Canal in Kutch from the perspective of small and marginal farmers.

- Detailed documentation of traditional knowledge on agriculture to revive agriculture systems in Kutch
- Exploring the opportunity for crop and cattle insurance.
- Network and alliance with formal and informal institutions like Setu, Dantiwara Agriculture Research Institute, Sajeev Kheti Manch, Gene campaign and Agrocel Industries Limited and co-operative societies present at the community level.
- Selection and promotion of crop varieties based on the inputs of the research institutions which needs to be first experimented with progressive farmers.

Annexure 1

Questionnaire for Focus Group Discussion for Different Key Stakeholders

Target Group: Farmers (Mixed Group)

- How do the farmers construct and deconstruct climate change
- Has there been any change in the weather pattern during the last 10 – 15 years [The focus is on temperature/heat or cold, rainfall (intensity, unpredictability, frequency)]
- Has there been any change in the cropping pattern during the last 10-15 years
- What do they think are the reasons for the change in cropping patterns
- How the changes have impacted the crop: in terms of types of crops, productivity, duration of the crop, input usage?
- How this has positively impacted agriculture
- How this has negatively impacted the agriculture
- How are the farmers adapting to the impact of climate change
- What you think should be done to enhance agriculture productivity
- Has there been a shift from the food production to cash crops? What are the reasons for the same? Do they think, this trend is in the right direction?
- What kind of an impact the Narmada Canal will have on the agriculture in the regions, in terms of types of crops.
- Please suggest 5 interventions that for NGO in farming and animal husbandry
- From whom did you get the information about the techniques to reduce the impact of climate change? or self-findings?

Target Group: Women Farmers

- Do you consider yourselves as farmers
- If yes, then why and if no then why not
- What are the different types of work you do on the farm land
- To what extent you are a part of the decision making process as far as farming is concerned. The question will focus on types of crops, period of sowing, fertilizer
- Has there been any change in the weather pattern in the last 10-15 years. If yes, what? Again the focus will be on rainfall, temperature, water level, salinity etc
- How the changes have impacted the crop: in terms of types of crops, productivity, duration of the crop, input usage?
- How this has positively impacted agriculture
- How this has negatively impacted the agriculture
- How are the farmers adapting to the impact of climate change
- What you think should be done to enhance agriculture productivity
- Has there been a shift from the food production to cash crops? What are the reasons for the same? Do they think, this trend is in the right direction?
- What kind of an impact the Narmada Canal will have on the agriculture in the regions, in terms of types of crops.
- Suggest interventions for INGOs in agriculture and Animal Husbandry

Target Group; Scientific/Research Institutions/Individuals

- Since Kutch is a large area, is there any way it is divided into different agro-ecological zones
- Where to get the information about the change in climate during the last 10-15 years. What is your nearest meteorological department station.
- How the changes have impacted the crop: in terms of types of crops, productivity, duration of the crop, input usage?
- How this has positively impacted agriculture
- How this has negatively impacted the agriculture
- How are the farmers adapting to the impact of climate change
- What you think should be done to enhance agriculture productivity
- Has there been a shift from the food production to cash crops? What are the reasons for the same? Do they think, this trend is in the right direction?
- What kind of an impact the Narmada Canal will have on the agriculture in the regions, in terms of types of crops.
- Is there any literature/study which should be referred to enhance the quality of the study
- Is there any person to be consulted to enhance the quality of the study
- Is there any impact of climate change on soil quality? If yes, how do we overcome this?
- Climate friendly agriculture practices in Kutch or the practices which can reduce carbon emission for various crops and where we can find more details about it?
- Is there any practice prevalent in Kutch which is carbon intensive or which has a high carbon footprint and what steps need to be taken to correct it.
- What policy change is recommended to reduce the negative impact of climate change on agriculture?
- What are the key issues, NGOs like *Cohesion Foundation Trust* should be working on to reduce the impact of climate change on agriculture?
- What do you do to teach the farmer community on the theme of climate change?

- what are you lab to land programs?
- Is there any research being done on this?

Target Group: Progressive Farmers

- Do you see any change in climate pattern in the last 10-15 years
- How this has positively impacted agriculture
- How this has negatively impacted the agriculture
- How are the farmers adapting to the impact of climate change
- What you think should be done to enhance agriculture productivity
- Has there been a shift from the food production to cash crops? What are the reasons for the same? Do they think, this trend is in the right direction?
- What kind of an impact the Narmada Canal will have on the agriculture in the regions, in terms of types of crops.
- Is there any person/progressive farmer to be consulted to enhance the quality of the study
- How have you adapted to the impact of climate change on agriculture
- What are the practices which can be adapted by the small and marginal farmers
- What kind of a support you can provide to small and marginal farmers in adapting to the impact of climate change

Target Group: Input Suppliers

- Do you see the change in agriculture pattern in this areas in the last 10-15 years
- What has been the major cause for changes
- How this has positively impacted agriculture
- How this has negatively impacted the agriculture
- In terms of inputs has there been any change in pattern by the farmers in the last 10-15 years
- Do different types of farmers (marginal, small, medium and big) behave differently in terms of buying inputs
- How are the farmers adapting to the impact of climate change
- What you think should be done to enhance agriculture productivity
- Has there been a shift from the food production to cash crops? What are the reasons for the same? Do they think, this trend is in the right direction?
- What kind of an impact the Narmada Canal will have on the agriculture in the regions, in terms of types of crops.
- Is there any person/progressive farmer to be consulted to enhance the quality of the study
- Is there any person to be consulted to enhance the quality of the study

Target Group: Government Officials

- How does the government define farmers? Is there any difference in the definition by the state and the central government?
- What are the major government departments associated with agriculture and livestock
- Is the government thinking about the impact of climate change on agriculture and livestock? Has there been any study been conducted by the government on the same?
- What are the various popular schemes by the government in agriculture and animal husbandry? What are the major schemes for the small and marginal farmers? Where we can find the details about the schemes?
- What kind of a work the NGOs should be doing on agriculture and animal husbandry and how the government can complement the same?

List of Crops with local name, common name and scientific name

S No	Local Name	Common Name	English Name	Scientific Name
1	Bajri	Bajri, Bajra	Pearl Millet, Spiked Millet	Pennisetum glaucum
2	Jowar	Jowar	Sorghum	Sorghum bicolor
3	Mug	Moong	Green Gram, Golden Gram	<i>Vigna radiate</i>
4	Moth			<i>Vigna aconitifolia</i>
5	Tul	Til	Sesamum	<i>Sesamum indicum</i>
6	Guar	Gawar, Guvar, Guwar	Cluster Bean	Cyamopsis tetragonoloba
7	Jeera	Zeera	Cumin Seeds	Cuminum cyminum
8				