RESPONSE OF THE NATIVES TO THE COLONIAL SCIENCE AND TECHNOLOGY

Chapter Three refers to the contemporary mode of production prevalent in pre-British Gujarat during the study period. The availability of copious variety of agrarian produce; secondary agrarian products like candid sugar, cotton and silk fabric, clarified butter or *ghee*, etc.; and non-agrarian commodities like woollen fabric, thread work in gold and silver, paper making, liquor, wood works, etc., amply bears that the pre-British Gujarat region enjoyed vibrancy and limitation in terms of mode of production; the process was scientifically advanced and attained global ranking. This is further testified with the ever increasing demand and attempts to fulfill not only the demands in the Indian Ocean rim but also its expansion in the newly developed Pacific Ocean routes as well. Chapters Three and Four further strengthen our understanding through the documentation of the mode of production and manufacturing process.

With the establishment of the British rule in India and Gujarat in particular, European technology was introduced over the period. In this chapter, an attempt will be made to understand about the acceptance and rejection of the European technology in British Gujarat by the natives.

Environment in British Gujarat

Establishment of the British rule in Gujarat opened new vistas for the introduction of number of imported technologies. This gathered momentum with the coming of the Europeans in general and the British in particular after 1850's. This perhaps happened due to the growing needs of industrialised Europe. If one surveys the political developments and the colonisation of South Asia, it can be stated that the extraneous factors and ambition of colonisers propelled the demand. In case of Gujarat, it has been observed by R. D. Choksey that the *Gujarati* populace was not always restrictive in accepting the changes in mode of production. We have earlier recorded that the individuals and group of people in Gujarat contributed to the making of modern British Gujarat. The case of Ahmedabad cotton mills, paper making, wood carving, etc., is best suited in our discussion.

Gujarati society many times did not respond overwhelmingly. A Number of production methods, new machinery, implements, etc., were rejected or were asked for modifications.

There were number of cases of *Gujarati* intellectuals who were known for their contribution in the growth of scientific atmosphere. Some of them were even actively reported for their participation in the successful assimilation of the European knowledge in *Gujarati* society. In one such example, *Buddhi Prakash* (a periodical published by Gujarat Vernacular Society since 1843 under the guidance of Alexander Kinloch Forbes) printed a picture of a railway train to arouse consciousness among the people regarding the benefits of the railways.[1] It is well known fact that in this initiative, he was supported by Dalpatram.

Prominent *Gujarati* intellectuals like Naoroji Fardunji, Mohanlal Ranchhoddas Jhaveri, Mahipatram Roopram, Karsandas Mulji were the product of Elphinstone College, Bombay. These individuals became the harbinger in the introduction and adoption of imported technology along with the endorsement of native mode of production. At the same time, the natives were also critical about the impact and implication of the imported knowledge which was introduced in Gujarat. *Hunnarkhan-ni-chadai* (Dalpatram's poetry) is a fascinating account of clash between Indian and British textile industry in this regard.[2]

Jayakrishna Indraji (1849-1929) wrote *Vanaspati Shastra*, *Baroda-ni-Vanaspati* and *Cutchni Vanaspati*. These texts are considered in high esteem as reference books. Hargovindas Kantawalla (1849-1932) wrote *Deshi Karigari-ne Uttejan* (Encouragement to Indigenous Arts and Crafts).[3] These cases show the potentiality and readiness of the people to understand the implication of the European technology.

[1] Mansukhlal Jhaveri (1978), *History of Gujarati Literature*, New Delhi: Sahitya Academi, 68-69.
[2] *Ibid.*, 76.
[3] *Ibid.*, 90-91.

Responses in Agrarian Sector

Agrarian set-up in pre-colonial Gujarat was the product of knowledge system developed since antiquity. Agricultural production related knowledge was acquired for generations together and had undergone process of suitable modification and adjustment with the environment. When the British established their rule in Gujarat during the first half of the 19th century, they had mixed impressions about the state of Indian agriculture and the knowledge of the cultivators. Some of them were critical of farmers skills and as we have discussed this earlier in Chapter Three. It is also observed that there were few Britishers and the Europeans who were surprised by the skills, methods and knowledge. They duly acknowledged the superior skills employed by the *Gujarati* farmers in the mode of agrarian production.

In the above context through largely commercial in motive, the British administration introduced seeds from the various colonies; hired number of experts and finally, institutionalised the agriculture department within British Gujarat territories along with other pockets of the Bombay Presidency. In case of food crop, they had little interest regarding increase of the yield of the varieties of the food crops. However, their deep interest has been noted in the cash crops production. A number of steps were taken to increase the yield as per the demand of the market across the world by introducing new agricultural apparatus / implements; techniques; seeds; fertilisers, manures, etc.

Responses in Cash Crops

Cotton

Cotton was the most preferred cash crop by the British in Gujarat. The textile mills in England worked on long staple cotton. In Gujarat, short staple cotton plants were cultivated. The British government decided to introduce long staple cotton seeds in various sub-regions of Gujarat from the various colonies. As noted earlier, Ahmedabad District evidenced the presence of Mr. Price, who encouraged the

cultivators of the sub-region to adopt the usage of New Orleans seeds.[4] The result was not encouraging. Similarly, the Collector of Kaira District encouraged the peasants for the cultivation of Bourbon cotton seeds despite its failure. The output of the cultivated Bourbon seeds was not satisfactory. The cotton obtained from the cultivation of Bourbon seeds were sent to London where it was rejected because it lacked the desired quality.[5] I would like to re-assert and draw attention towards the cotton related experiments carried out in British Gujarat. The experiments were carried out with foreign cotton namely New Orleans, Parnambuco, Bourbon and Egyptian. It was reported that the results were not satisfactory owing to the low yield and lack of desired quality. Mr. Daley at Surat was also reported to face the same fate when he tried to cultivate exotic cotton seeds.[6] The cultivators showed their willingness to cultivate exotic cotton seeds, but they were discouraged by its yield and quality. The peasants continued to cultivate the local cotton staples. Convinced with the superiority of local cotton staples, it was decided to carry out experiments on local strains along with improved foreign ones. Further, with the establishment of the various agricultural experimental stations in British Gujarat, number of local strains was made available and these fulfilled the outside and local demand.

The *Gujarati* cultivators who used their indigenous skills for the cultivation of local cotton staples were the strength of the vibrant textile industry of Gujarat. They were acknowledged for their knowledge about the cultivation of cotton plants and were appreciated by some of the Britishers. The experts in cotton cultivation like Messers Mercer, Simpson and Hawley were of opinion that the skill exhibited by the peasants in Gujarat about their agricultural operations was superior and that their economic system enabled them to obtain much larger returns.[7] They were, further impressed, with the native mode of agriculture; the careful manure making; the rotation of crops; the implements; climate and native's genius as an agriculturist.[8]

[4] W. R. Cassels (1862), *Cotton*: *An Account of Its Culture in Bombay Presidency*, Bombay, 14.
[5] *Ibid*.
[6] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 134.
[7] *Ibid*.
[8] *Ibid*.

It is discussed in Chapter Three that natives actively participated in the cultivation of cotton. A large house at Amjad Bag near Broach in 1834 was granted rent free to a Parsi named Merwanji Hormasji. Besides cultivating exotic cotton seeds in the *bag*, he established screws and warehouses. The machinery was established in order to obtain clean cotton and its packing and storing.[9] Further, in 1880's, it was reported that Sardar Bamanji A. Dalal, executive officer used 3500 acres of waste land in Halol *taluka* exclusively for cotton cultivation. He also initiated cotton cultivation with the employment of improved drill system.[10]

In the field of controlling the damage of cotton plants by insects and pests, certain important initiatives were taken by the government. 'Clean up Measure' was one such step.[11] Under this measure, peasants were encouraged to uproot cotton plants after removing *kapas.* It was observed that uprooting of the cotton plants was one of the best methods to control the growth of malicious weeds. Natives used simple implements like *kudali* to remove cotton plants from the soil. Though the practice was best suited to the local agricultural practices, it was ascertained that the native implements were unable to uproot the cotton plants from its roots. To overcome this limitation to remove pests, the British Government introduced an implement called 'Plant Puller' for uprooting plants.[12] The puller served its purpose effectively. It was reported that the implement found acceptance among the populace as it was economical and designed as per the local needs. The scheme was introduced in Surat and Broach.[13] The government decided to manufacture this instrument at a low price of Re. ½ per puller at Baroda so that it could be purchased by the peasants. To overcome the bias prevailing among the natives against the uprooting cotton plant, an extensive educational propaganda was undertaken for explaining the damage caused by this pest. It was decided to attract the populace by organising magic lantern lectures, demonstration of working of the pullers, holding competitions and awarding medals and prizes.[14] The publicity officer of the Indian

[9] *GBP* (1877), *Surat and Broach*, 396.
[10] M. S. Commissariat (1938), *A History of Gujarat*, Vol. I, 186-87.
[11] B. P. Deshpande and N. T. Nadkarny (1936), "Spotted Boll-Worms of Cotton in South Gujarat, 1923-31", 15.
[12] *Ibid*., 20.
[13] *Ibid*., 19.
[14] *Ibid*., 20-21.

Central Cotton Committee was instructed to supervise the initiatives. He distributed illustrated hand bills, leaflets on the advantages of the measures.[15] Beside this, he also sougth the support of leading newspaper for its wider publicity and even personally visited to the tract where the propaganda was carried on. The result was encouraging and cultivators were responsive to the British initiative.[16] The case shows that whenever government with good intention tried to introduce innovation, it was happily accepted and adopted by the peasantry.

Silk

In continuation with the experiments in cotton staples, silk received limited attention because the region was not suitable for silk procuring. It was reported that in 1837, under a Civil Surgeon, a government garden was established at Kaira.[17] Experiments were performed for the growth of mulberry trees and rearing of the silk worms. Further, it was observed that by 1838, in the government plantation on the banks of Shedhi, near the Kaira Bridge about 800 trees of the St. Helena species were planted and reported all thriving uncommonly well.[18] In 1840, Dr. Burn reported his plantation in a flourishing condition. It was estimated that it had fed 60,000 worms and some silk had been reeled.[19] The government understood its limitation and decided to seek the help of the natives by providing training in silk culture. In this regard, three *Gujaratis* youth were given allowances to learn reeling under Signor Mutti, who was employed by the government in Deccan.[20] Kaira experiments were continued for some years. Unfortunately, the experiment was pronounced as less effective. In 1844, Dr. Thatcher, in charge of the garden reported that these plants suffered from heat. The experiments did not receive general acceptance among the natives. Local people did not like the killing of the worms, and therefore, they did not adopt it on wider scale.[21]

[15] *Ibid*., 21
[16] *Ibid*.
[17] *GBP* (1879), *Kaira and Panch Mahals*, 54.
[18] *Ibid*.,.
[19] *Ibid*., 55.
[20] *Ibid*.
[21] *Ibid*.

Indigo

The discovery of artificial indigo led to the decline of indigo cultivation in British Gujarat.[22] There were other reasons as well for decline. It was reported in one of the *Revised Revenue Survey Settlement Report* of Borsad *talukas* (1895) that indigo was not cultivated; the destruction of animal necessitated in the preparation of the dye was looked as sin. There was general agreement among *Patidars* not to grow it.[23] The unpleasant smell produced in the process of manufacture was considered deterrent.[24]

Sugarcane and Sugar Manufacture

Sugarcane cultivation, further, received the attention of the government as well as the natives. Both responded to the improvement of sugarcane staples. Colonel Sleeman introduced exotic canes in western India. Framjee Oowsjee Esq., Mr. Sundt and Hurrybhai Omerashankur, *Mamlatdar* of Chowrasi *taluka* of Surat were known for the introduction of Mauritius cane in Surat.[25] The acceptance of exotic canes was time consuming as these were not generally accepted by the cultivators. The exotic canes were soft and liable to be attacked by white ants and jackals. Further, canes could be easily injured by the action of winds and prey to the pilfering proclivities of the people. It was pronounced not fit for *gur* making. Therefore, natives preferred indigenous canes with small staples and hard bark which could withstand white ants, jackals, winds, severe drought, inundation, swampy soils and high temperature.[26] The government took some remedial measures to check the agency known for causing damage to the canes. In one such initiative, *suran* and groundnuts crops were cultivated along with canes to control the damage, but with limited result. The other alternative of shooting of pigs and jackals in Surat followed the same fate. Mr. T. N. Jhaveri, Entomological Assistant, adopted poisoning method for killing the animals and even tried to convince the villagers about its utility. It was

[22] *GBP* (1879), *Ahmedabad*, 58.
[23] "Papers Relating to the *RRSS* of Borsad *taluka* of Kaira Collectorate" (1895), 4.
[24] *Ibid*.
[25] George Watt (1897), *A Dictionary of the Economic Products of India*, Vol. VI, Pt. II, Calcutta, 42.
[26] *Ibid.*, 82-83.

reported that cultivators gradually started using poisons and many of these animals were killed while consuming it.[27]

Baroda State was classic example for the cultivation and production of sugar by hiring experts and latest machinery were purchased. Maharaja Sayajirao Gaekwad III took various measures to improve the manufacture of sugar by establishing sugar industry in his territory. Mr. P. S. Melbill, Agent to the Bombay government was consulted on this matter.[28] Raoji Vittal was Sayajirao's agent who was deputed to supervise the experiments for sugar manufacture.[29] Diwan Sir T. Madhavrao abolished sugar monopoly in the State to encourage private participation in this field.[30]

In the further initiative, three sugarcane-pressing mills were purchased by Baroda State namely placed in Gandevi (Navsari), Baroda and Amreli. Detailed reports with samples of sugar manufactured were sent to Prof. E. Kinch, Royal Agriculture College, Cirencester, England and to Dr. Brandes, Gottingen, Germany for analysis.[31]

Iron mills which were introduced in Gujarat were not accepted because these were costly. It cost Rs. 110 at Poona. In contrast, a wooden mill cost from Rs. 35 to 50. Iron mill extracted 73% of juice while native wooden mill would yield 50% to 60%. The acceptance of iron mill was, further, discouraged as it spoiled the quality of *gool* by turning it darker. But iron mill had one advantage that it required less repairs in comparison to wooden one. [32]

Tobacco

Kaira District received maximum attention for the cultivation of tobacco. As discussed in section 'Tobacco' in Chapter Three, various foreign tobacco staples were tried with limited output. The British government was convinced with the

[27] *Annual Report of Department of Agriculture of the Bombay Presidency* (1920-21), 63-64.
[28] "Correspondences Regarding the Manufacture of Sugar" (1876-88), 49.
[29] *Ibid*.
[30] *Ibid*.
[31] *Ibid.*, 289-91.
[32] P. R. Mehta (1905), *The Elements of Agriculture of the Bombay Presidency*, 198-99.

suitability of the local strains of tobacco and next phase of experiments was based on improving the local strains to fulfill their demands for cigarette manufacture.

Natives were active participants for the successful exploitation of tobacco in Kaira.[33] Bechardas Veharidas Desai initially had applied for 500 acres in *Mal* (less productive tracts outside *Charotar*) area. The government provided him with the required land with special conditions that he would promote tobacco cultivation which was accepted by him.[34]

The government was convinced about their limitation regarding the success of exotic tobacco seeds. It was decided to seek the help of the natives in terms of providing expertise assistance with monetary provision. It was reported that though assistance was provided from the government side, lead in Kaira for tobacco cultivation was taken by late Rao Bahadur Sardar Bechardas Desai of Nadiad.[35] An association of local people under his guidance was constituted to introduce different kinds of foreign tobacco cultivation in Nadiad.[36] Its members were reported for using improved methods of tobacco curing. The money generated for the association was totally a local effort. Further, he opened an experimental station with curing sheds facility. He also hired foreign experts and a factory for cigarettes and smoking mixtures was opened.[37] Unfortunately, we have limited information about his role in the development of tobacco cultivation in Kaira.

Baroda State was also active in the introduction of exotic tobacco seeds. It was also reported that Petlad sub-region of Baroda State produced superior quality of tobacco.[38] Skilled staffs were appointed to promote tobacco cultivation in the tobacco producing tracts. Rao Bahadur Vinayakrav Janardhan Kirtane, *Naib* Diwan

[33] Harold H. Mann, M. L. Patel and V. M. Majmudar (1926), "The Improvement of Tobacco in Northern Gujarat", 7.
[34] Vinayak Chaturvedi (2007), *Peasant Pasts: History and Memory in Western India*, 37.
[35] Harold H. Mann, M. L. Patel and V. M. Majmudar (1926), "The Improvement of Tobacco in Northern Gujarat", 7.
[36] *Ibid*.
[37] *Ibid*., 8.
[38] *GBP* (1883), *Baroda*, 90.

of the State was doing best to introduce a more scientific process for curing and dressing of the tobacco leaf.[39]

For the successful exploitation of griculture in order to increase the yields of the crops, different types of tools and implements were used by the cultivators. These instruments were based on the need of the soil and the nature of the crops. Establishment of the British rule opened new vistas for the change in the structure and pattern of instruments. The British government introduced some tools and instruments in Gujarat. The introduction of these instruments witnessed the acceptance and in some cases its outright rejection by the cultivators.

Plough and Other Tools

Native plough enjoyed the confidence of the cultivators since antiquity and it was widely employed in the tilling of the land. The British government tried to introduce European plough in Gujarat to increase the yield of the crops. An attempt was made in 1843 to introduce American plough.[40] It was given for trial to local farmers. It was not accepted by the farmers. Peasants complained that the ploughs were clumsy, the furrows were too wide and the work of levelling was much heavier in comparison to the ordinary ploughing. It was also estimated that American plough was costly in contrast to local plough manufactured in Kaira District.[41] Mr. Kirkland, the Collector of Kaira was of the opinion that these introduced ploughs demanded more skills and required expertise help.[42] In 1875, another attempt was made to introduce an improved plough of the British origin.[43] Three ploughs were tried in Kaira, Nadiad and Borsad. The British ploughs were not rejected, but found with very limited acceptability among the cultivators.[44] The faults found were that the share was too long and made the work too heavy for one pair of bullocks. These ploughs could not be guided with the hand to plough and derive and the bullocks required two men instead of one.[45] The next Collector, Mr. Sheppard was of the

[39] *Ibid*.
[40] *GBP* (1879), *Kaira and Panch Mahals*, 55.
[41] *Ibid*.
[42] *Ibid*.
[43] *Ibid*.
[44] *Ibid*.
[45] *Ibid*.

opinion that if the handles of the plough could be joined by a cross-piece, it could become popular. In December, 1878, Mr. Robertson, the Superintendent of the Madras Government Farm visited Nadiad.[46] Some ploughs were accordingly ordered from the Madras Government Farm. It is reported that three cultivators belonging to large landowning *Patidar* families were send to the Madras Farm to learn scientific farming.[47]

In south Gujarat extreme, Salsette cultivators objected to the imported plough.[48] It was pronounced too heavy for functioning by self and the cattle. It was estimated that its price was much higher in comparison to the native plough.[49] Hence, its acceptability remained negligible or limited.

The nature of soil in England is different from Indian condition. In England essential nutrients for plant growth are slightly deeper in comparison to India upper crust of soil, and therefore, heavy ploughs are employed by the cultivators. With this notion, the government introduced heavy iron ploughs. Their understanding about the native ploughs was that its wooden share did not insert the soil and went to a depth of only three or four inches.[50] Native cultivators were well aware of the nature of soil and put the seed a little way into the ground.[51] This practice also prevented the decay of the seeds. Conserving moisture, exposure of weeds and slices to the sun, availability of lime stone and *kankar* into the depth of the soil and the uncertainty of rainfall, all these factors affirmed the preference of Indian peasants and his wooden-shared plough against deep ploughing.[52]

The government was dissatisfied about the wood made plough and they inserted iron in the native plough.[53] The iron coulter in plough introduced was

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[46] *Ibid*.
[47] *Ibid*.
[48] Alexander Walker, "Indian Agriculture", in Dharampal (1971), *Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts*, 183.
[49] *Voelcker Report on Indian Agriculture* (1897), 217.
[50] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 130.
[51] *Ibid*.
[52] *Ibid*.
[53] Vijaya Ramaswamy (2011), "Craft Technologies and Craft Communities in Peninsular India: An Overview of 16th to 18th Centuries", 93.

rejected by the cultivators as it prevented the erosion of the substances present in the surface soil like alkaline substances and minerals that were beneficial for the crops.[54]

From the above discussion about the plough, it can be ascertained about the superiority of tools used by the natives. The British intervention was pronounced failure, but one should be careful about the initiatives of the colonisers. There were some areas where their interest led to improvement of existing machinery for the benefit of the natives. For example, it is reported that the designs of the traditional bullock-cart were improved by an Englishman, who replaced the normal solid wheels with a spoked version.[55] The improved design created enough demand by the peasants. It is a classic example of the readiness of the rural economy to adapt to fresh demands, if introduced to suit the local requirements.[56]

In Broach, when the government attempted to introduce a new kind of cotton gin in the 1840s, it was rejected because it involved more labour than the traditional cotton cleaner.[57] As discussed in section 'British Attempts to Colonise Cotton: Gin Machine and Its Limitations' in Chapter Four, it took decades to understand the suitability of the local instruments and introduction of cleaners were perfected to work on short cotton staples produced in Gujarat. Twenty years later, the Platt Macarthy roller-gin was introduced and it was gradually accepted as it required less labour than the old method. It also supported the old native cleaner.[58]

There are number of cases about the native's initiatives to introduce tools for the benefit of peasants. Laxmanrao Kirloskars (Maharashtraian Brahmin studied at J. J. School of Arts and taught at Victoria Jubilee Technical Institute, Bombay) started manufacturing iron ploughs and chaff-cutter.[59] His efforts led to the introduction of a hand decorticator for groundnut cultivation which proved great boon to the farmers of the western India. A diesel engine and a centrifugal pump were added to enhance

[54] *Ibid.*
[55] Claude Alphonso Alveres (1979), *Homo Feber: Technology and Culture in India, China and the West: 1500-1972*, New Delhi: Allied Pub., 165-66.
[56] *Ibid*.
[57] Cathy Chua (1968), "Development of Capitalism in Indian Agriculture: Gujarat, 1800-1900", 2098.
[58] *Ibid*.
[59] Dwijendra Tripathi and Makrand J. Mehta (1990), *Business Houses in Western India: A Study in Entrepreneurial Response, 1850-1956*, 131.

irrigation. Further, *Kirloskar Journal* was published to educate and spread the importance of various products of the factory of Kirloskar.[60] *Kamal* was a sugarcane crushers.[61]

Irrigation

The improvement in case of tools and implements was in the reach of the natives and the British government. In case of irrigation, it was a difficult process. It demanded huge expenditure. The limited financial capacity of the natives was a negative aspect. Further, the small irrigable lands and substantive form of farming practiced by the farmers were some of the limitations which discouraged the acceptance of mechanised irrigation in British Gujarat.[62]

The government decided to construct canals and experts were entrusted with the task to survey the appropriate regions. It was reported that in 1856, Captain Trever (Bombay Engineer) surveyed Surat and proposed the construction of a canal from Tapti River. For its execution, Captain Chambers who had worked on the rivers of the Madras Presidency was entrusted with the task to construct canal on the selected spot as advised. Captain Chambers, further, suggested the construction of a canal fifty miles running to the south west to Auranga River near Valsad in south Gujarat. Dissatisfied with the results which cost heavy expenditure to the government, Captain Trever in 1867 was asked to report on Chambers proposal. Finally, masonry weir across the Tapti at Kamlapor, thirty five miles from the city of Surat was made for the irrigation of the nearby areas.[63] As discussed in section 'Rivers and Canals: Natural Limitations' in Chapter Three, the failure in the construction of canals in British Gujarat was not the failure on the part of government. The natural barriers and topography of the sub-regions did not permit the construction of canals and existing technology was inappropriate to overcome the natural limitations.

[60] *Ibid*.
[61] *Ibid*.
[62] J. M. Mehta (1930), *A Study of Rural Economy of Gujarat Containing Possibilities of Reconstruction*, 71.
[63] *GBP* (1877), *Surat and Broach*, 15-17.

In the next attempt, the government introduced British pumps. The pumps did find mixed reaction among the natives. It was reported that a cultivator installed a first class pumping plant on the Sabarmati River. He abandoned the use of pump because it was difficult to operate.[64]

Over the period of time, water pumps were gradually accepted. It was reported that large number of tube wells and pumps were in operation in *Charotar* tract in Kaira District.[65]

Pumps run by oil engines were tried in Matar *talukas*. These were installed near river, but were of no avail owing to its remoteness from the city. The machines required frequent repair work. There were generally few skilled engineers available whose service could be sought for the repair of these machines.[66] By 1911, fourteen boring machines were in operation in Kaira District. The machinery was expensive and peasants could not afford it.[67]

The reason for the limited acceptability of introduced machines was its high cost and these required frequent help of experts which were not available. It was also reported that when these were in use, the water level in the well decreased rapidly.[68]

Animal Husbandry

Animals were vital element for the productivity of agrarian society. As discussed in section 'Animal Husbandry' in Chapter Three, Gujarat's cattle were known for its strong stature and copious mulching traits. The cattle dung was considered best manure for the growth of crops.

The British authority was convinced with the superiority of Gujarat's cattle and tried to introduce some innovations. To preserve the breeds which were on the verge of extinction, the Government of Bombay directed the district local boards of

[64] *Annual Report of Department of Agriculture of the Bombay Presidency* (1917-18), 8.
[65] David Hardiman (2006), *Histories for the Subordinated*, 348.
[66] "Papers Relating to the Second *RRSS* of Matar *Taluka* of Kaira Collectorate" (1900), 4.
[67] David Hardiman (2006), *Histories for the Subordinated*, 346-47.
[68] *Ibid.*, 347.

British Gujarat districts to propagate '*Bahamni* bull', an ancient practice of the natives of dedicating a bull to the God. The bull was the common property of the entire village and its upkeep was their responsibility. This practice was on the verge of decline and the initiatives of the government did not change the situation. It is reported that it did not find much attention of the people.

Another significant contribution of the government was the establishment of cattle farms along with the veterinary department with experts on animal husbandry. In these cattle farms, numbers of indigenous cattle were crossed to suit the specific purpose. It was decided to distribute these hybrids to the natives for the general improvement of cattle stock. The Civil Veterinary Department in 1907 started giving developed bulls in the farms to the peasants for breeding purpose. In 1918, a new section for cattle breeding started under the agricultural department and a special Deputy Director of Agriculture for animal breeding was appointed. The Northcote Cattle Farm at Chharodi which was started as a preservation society in the famine of 1899-1900 was supervised by him.[69] In 1921, forty nine of the best cows were selected to improve their milking qualities. Native's institution known as *Panjrapoles* and *Gaurakshaks* were generally used by the natives for the improvement of breed.[70] The Veterinary Department started inoculation to prevent diseases of the cattle in due course of time.[71]

Some of the communities in Gujarat had no religious bias in castrating their animals and they were the chief cattle breeders. The two *Koli* villages of Karanj and Ichhapore were reported to breed bulls by procuring them from the Athwa Agricultural Farm, Surat.[72]

[69] J. M. Mehta (1930), *A Study of Rural Economy of Gujarat Containing Possibilities of Reconstruction*, 198.
[70] *Ibid*.
[71] *Ibid.*, 199.
[72] J. B. Shukla (1937), *Life and Labour in A Gujarat Taluka*, 147, 50.

Enhancing the Soil Fertility

The natives were praised by the British Government about their skills to maintain soil fertility of lands which enabled them even to cultivate three crops in a year.

Government initiated the reclamation of salt effected lands in coastal regions.[73] Pinjarat village in Olpad *taluka* was reported for the introduction of this initiative.[74] Mr. Dhirajlal Umedram, a former district Deputy Collector had undertaken to reclaim three hundred and twenty eight acres of salt lands of which seventeen acres had become fit for cultivation. In 1888, one hundred and sixty four acres of salt lands were granted jointly to Mr. Lallubhai Kunverji of Rander and Mr. Khandubhai Khusalbhai, executive officer of Pinjarat for the same purpose.[75]

As discussed in Chapter Three, Voelcker was impressed with urine pit used in Nadiad *taluka* of Mr. Becherdas Viharidas Desai, a *Patidar*. The collected urine in the pit was used as excellemt manure without any smell.[76] Unfortunately, the sanitary authorities were misunderstood and ignorant of science behind the manure making in the pit and they tried to stop this practice. When the cultivators protested against the action of executive officers, the Collector introduced a system of pass to be renewable annually.[77] But the permission and rules prescribed was cumbersome. It is reported that it was on the verge of decline. The view of Voelcker's was supported by T. R. Fernandez, Deputy Superintendent, Gujarat Revenue Survey to revoke the pass system.[78]

Dr. H. H. Mann, former Principal, Poona College and Director of the Agriculture Department of the Bombay Presidency was highly impressed by the native's knowledge about the agricultural practices and was firm believer of active association of natives for the improvement of agriculture. As discussed, his

[73] *Ibid.*, 178.
[74] *Ibid*.
[75] *Ibid*.
[76] "Papers Relating to the *RRSS* of Nadiad *Taluka* of Kaira Collectorate" (1895), *SRBG*, No. 295, NS, 5-6.
[77] *Ibid*.
[78] *Ibid.*, 128-29.

recommendation for monetary help to the cultivators was rejected by the *Royal Commission on Indian Agriculture* (1928).[79] But at the same time, government accepted his request to expand the government demonstration farms and plots managed by the agriculture departments; permission to use the services of non-official agency. In this environment, for example, Chunilal V. Mehta, Minister of Agriculture established *Taluka* Development Association for the advancement and it was reported working well.[80] Mann further urged employment of demonstrators to spread the use of improved implements, better seeds, formation of co-operative societies, etc. among the natives. It is reported that natives supported the co-operative societies with the help of subscription and these societies also received grants from the *Taluka* and District Local Boards.[81]

Agriculture education also received the attention of the government and the natives. We have discussed that the Baroda College introduced agricultural department in collegiate education under the supervision of Prof. T. H. Meddleton, a qualified agriculturist from the Edinburg University.[82] The syllabus of this department was recognised by the Bombay University for training students for diploma course in agriculture.[83]

Government under the recommendation of Voelcker established model farms and agricultural classes were started at Surat and Nadiad High Schools. Besides other subjects taught here, agriculture education was promoted as a subject. Voelcker visited Nadiad School and reported as follows: "At Nadiad the Agricultural class is attached to the high school, agriculture being an optional subject in the school. The farm of the Nadiad Agricultural Association is utilised for the instruction of the class."[84]

[79] H. H. Mann, *The Social Framework of Agriculture: India, Middle East and England*, ed. by Daniel Thorner (1967), 264.
[80] *Ibid.*, 264-65.
[81] *Ibid*.
[82] S. N. Sen (1991), *Scientific and Technical Education in India, 1781-1900*, 451.
[83] *Ibid*.
[84] *Ibid.*, 452-53.

There were numerous cases of active participation of the natives to adopt new information if it was available. For instance, they surprised the government by their marked presence at agriculture exhibition held at Alipore (1864).[85] Similarly, Mr. Bhiambhai Morarji Desai, Superintendent of Surat Agriculture Station organised on 8th November, 1908, a large demonstration at Surat to show the cultivators experiments of the farm, implements and machinery and skills used in the management of dairy.[86]

Kala Bhavan (established in Baroda State in 1890) emerged as an experimental laboratory by purchasing machines from Liebold of Germany, Mathison of Glasgow, Windsor & Norton as well as Burshiani from England for their judicious exploitation for the improvement of agriculture.[87] It is reported that lathes, drilling machines and other essential equipment were fabricated at *Kala Bhavan*.[88] It manufactured oil engine valves, handlooms, sewage destroyer, discharge pipes dobby, beaming machine, etc.[89]

Responses in Non-Agrarian Sector

Natives were active participant in the adoption of new technology in the non-agrarian fields as well. The introduction and its assimilation were multilayered. Some of imported knowledge were successfully became the part of the production methods; others were rejected or did not satisfy the demands of the people at large and they continued with indigenous methods.

Cotton Textile Mills

The first serious effort to establish a cotton textile mill by a native came from R. B. Ranchhodlal Chhotalal from Ahmedabad who without the support of the

[85] Deepak Kumar (1984), "Science in Agriculture: A Study in Victorian India", 195.
[86] *Annual Report of the Surat Agriculture Station* (1908-09), 1-2.
[87] Dhrub Raina and S. Irfan Habib (2004), *Domesticating Modern Science: A Social History of Science and Culture in Colonial India*, 184-85.
[88] *Ibid.*, 188.
[89] Dhrub Raina and S. Irfan Habib (2004), *Domesticating Modern Science: A Social History of Science and Culture in Colonial India*, 188-89.

government established mill in the region.[90] The machinery was procured from England by Dadabhai Naroji.[91] It is also discussed that first consignment was lost but second order was placed and machinery reached at the port of Cambay and the mill was started on 30th May 1861.[92] Gradually more number of mills was established in Ahmedabad. Initially coarse yarn was made. Improved machines were further obtained for the manufacture of other varieties of cloth. Thick *madar path*, *dhoti*, *sari* and the thread below twenty counts was produced.[93]

The leacing citizens of Ahmedabad were aware of the advantages of mills and to combat the threat of the British mills Ahmedabad, following luminaries namely Ambalal Sakarlal Desai, Ranchhodlal Chotalal and Hargovindas Kantawala established an organisation called *Ahmedabad Swadeshi Udoyag Vardhak Mandali* in December 1875.[94] This organisation started spreading technical information about opening of modern industries by series of lectures, articles, books and exhibitions.[95] The *Mandali* carried on its constructive activities and played a role of information gap filling. Graduaaly, the activities of this organisation led to the opening of few small-scale manufacturing units like the leather, carpet, ink, metal, safety match and factories emerged in Ahmedabad in the late 19th century.[96]

In 1905, Lalbhai from renowned Shantidas Jhaveri family started Raipur Mills. The Asoka Mills was set up in 1920. His son Kasturbhai in 1930 started Arvind Mill producing fine quality cloth. Aruna Mills (1928) and Nutan Mills (1931) were further established. From 1928-38, he emerged as one of the biggest textile magnet of Ahmedabad.[97]

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[90] N. K. G. Parikh (1962), "Cotton Industry in Ahmedabad", 24.
[91] *Ibid*.
[92] *Ibid*.
[93] *Ibid*.
[94] Makrand J. Mehta (1981), "Business Environment, Urbanisation and Economic Change in India: A Case Study of Ahmedabad in the 19th Century", 9, 11-12.
[95] *Ibid*., 12.
[96] *Ibid*.
[97] Dwijendra Tripathi and Makrand J. Mehta (1990), *Business Houses in Western India: A Study in Entrepreneurial Response, 1850-1956*, 91-95.

Lalbhai was advised by his cousin, Chinubhai Manibhai to start a factory to manufacture starch to be used in mills. It was not manufactured in Gujarat at that time. Lalbhai was interested in the proposal because Panch Mahals was known for surplus maize production. Even, Chinhbhai went to Bombay University to learn chemical technology. Anil Starch Products was registered in 1938 and started production in 1941. Machines were imported from Germany.[98]

Another interesting story is of Mafatlal (*Kunbi* by caste) who worked as a mill boy. In 1912, he purchased a mill near Nadiad and named it New Shorrock Mills. He also took over the ownership of Jaffar Ali Mills founded in 1865 by Nawabs of Surat. The profit generated from these mills enabled him to open series of retail shops in Bombay, Calcutta, Bangalore and Amritsar. He also acquired China Mill founded by a Parsi family in 1887. Further, he took over Standard Mills controlled by the Tatas in 1927.

He also established ginneries in the cotton growing regions of Gujarat under the co-ordination of Parikh & Co. in Bombay. By 1930's, he started Mafatlal Fine Spinning & Manufacturing Company owning to government decision to give concessions for fine cloth. Production facilities were located at Navsari in Baroda State to enjoy tax rebate from the Gaekwad. In 1933, he took over the management of the Indian Bleaching Dyeing & Printing Works at Bombay. Besides this, he also ventured into other fields. He set up Gagalbhai Jute Mills at Calcutta in 1929. Further in 1943, he acquired the Mysore Commercial Union which was manufacturing plywood doors and beards.[99]

Powerloom

Powerlooms were introduced in British Gujarat to manufacture cloths in the first half of the 20th century when the availability of electricity was made possible. The natives of British Gujarat actively participated in the use of powerlooms. It is reported that by 1920s, Surat *jari* manufacturers imported wire plates which enhanced the working capacity as compared to the native methods. The powerloom

[98] *Ibid.*, 96-97.
[99] *Ibid.*, 106-12.

and its plates of required configuration were imported. Another important factor which encouraged the use of this machine was that it could be fitted on to the old frames on which the artisans worked. Further, steel was replaced by firmer metals (hard-coated drawing holes), plated steel, brass plate to make the machinery to withstand wear and tear.[100]

Douglas Haynes refers to the adjustment made in the powerloom and its gradual acceptability among the weaving families. The Surat Electric Company (then Killick, Nixon & Co.) in Surat during the 1920s encouraged weavers to use powerloom. The company helped the weavers about its technicalities and did all the electrical fittings for the working of powerloom.[101] It is reported that some of the artisans convinced with its usefulness and assistance provided by the company opted for it. Further, it required less capital, land etc. In case of non-availability of electricity, generators were used. In Surat, number of local artisans simply transformed their Hattersley looms by adding a belt and some other small contrivances made it possible for electricity to derive the weaving action.[102] A converted Hattersley typically cost about Rs. 60. It is also reported that weavers purchased old machinery from the mills of Bombay and Ahmedabad that were either upgrading their machinery or went out of business.[103]

In another case, Hiralal Bachkaniwala purchased three powerloom by 1938. Aware of the usefulness of the powerloom, he was reported to convert Hattersley looms at a cost about Rs. 60 per machine. By 1950s, his family developed a small factory with fifty looms.[104]

Surat powerlooms users opened new chapters in the manufacture of artificial fabrics. It is reported that native weavers adopted new changes for the manufacture of men-made fibre like rayon, nylon and polyesters. Some powerloom operations

[100] Tirthankar Roy (1999), *Traditional Industry in the Economy of Colonial India*, 114.
[101] Douglas Haynes (2001), "Artisan Cloth Producers and the Emergence of Powerloom Manufacture in Western India", 1920-50", 183.
[102] *Ibid.*, 184.
[103] *Ibid*.
[104] *Ibid*., 187-88.

began adopting viscose yarn during the 1930s which were imported from Japan.[105] Nur Mohammad Peer Mohammad at Surat converted the traditional loom into powerloom during the mid-1930s. Within a year, he was manufacturing fine cloth, bordered *saries*, high-quality shirt, suit material and linen.[106]

The adoption of powerloom was not an easy process and we do have some case of resistance from the artisans who were known to work with traditional machinery since generation. In Surat, some weavers who installed Hattersley looms were forced to work behind closed doors. They were scared about the negative reactions from the other weaving families. There was in sum total, no mass violent action in the western India when powerlooms were introduced.[107]

Artificial Dye

The introduction of artificial dyes in British Gujarat destroyed the tradition dyeing industry. Artificial dye aniline or alizarin which was tried gained the attention of the native dyers owing to its cheapness. It demanded moderate labour requirement and less time for its execution. In this turmoil situation, the natives showed their active participation by adopting imported dyes. Prof. T. K. Gajjar introduced the manufacture of alizarine (artificial dye for indigo) at *Kala Bhavan* in Baroda State as it was costly at that time.[108] Gajjar adopted German technology and appointed Prof. Hugo Schumacker from the giant dye manufacturing concern Farber Fabriken and Dr. Erbehardt from Germany. Schumacker was helped by Maganlal Chottalal Desai from Baroda College. The institute with the help of German experts started manufacturing dyes of different texture.[109]

[105] *Ibid*., 189.
[106] *Ibid.*, 191.
[107] *Ibid.*, 190.
[108] Dhrub Raina and S. Irfan Habib (2004), *Domesticating Modern Science: A Social History of Science and Culture in Colonial India*, 190.
[109] *Ibid.*, 191.

Silk Fabric

Silk fabric manufacture received limited response from the natives when the British tried to introduce innovation. A silk factory was started by Mr. Joshi[110], a Parsi, to manufacture thick and strong watered silks entirely for the market of France. The silk was considered in the markets of France as good quality genuine Lyons silk.[111] In Surat, before 1900, an attempt was made to introduce artificial silk made in France; but the initiative was abandoned. The probable reason for its rejection was that it could not be dyed properly.[112]

Wood Carving

Messers Mulchandbhai Hathising & Brothers from Ahmedabad were known for their skills in manufacturing excellent quality of wooden articles. Their products manufactured in the farm were recognised even outside India. It was reported that the farm received certificates from Antwerp and other internationally held exhibitions. Their skill in wood carving was also acknowledged both in Europe and America.[113] It is reported that their farm employed about one hundred and twenty five men at a time.[114]

Paper Manufacture

Paper traditionally manufactured by hand in British Gujarat began to collapse when the British machine made paper were manufactured in the Bombay Presidency. In this situation, the natives showed their active participation by starting mills to manufacture paper. In one of the recorded information, during 1873, the traditional paper manufacturers of Ahmedabad set up a steam operated paper mill.[115] In 1877, Jamaludin Muhammadbhai set up a paper mill with two steam-factories and two engines employing about fifty persons daily.[116]

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[110] R. D. Choksey (1968), *Economic Life in the Bombay Gujarat, 1800-1939*, 230.
[111] *Ibid*.
[112] S. M. Edwards (1900), *A Monograph upon the Silk Fabrics of the Bombay Presidency*, 6.
[113] J. A. G. Walls (1902), *A Monograph on Wood carving in the Bombay Presidency*, 5.
[114] *Ibid*.
[115] Makrand J. Mehta (1982), "Indigenous Paper Industry and Muslim Entrepreneurship: Case Study of Paper Technology and Trade of Ahmedabad with Special Reference to the 19th Century", 56.
[116] *Ibid*.

Glass and Other Works

Kapadvanj in Kaira District was noted for traditionally glass made articles. The introduction of cheap European glass products proved disastrous to this native industry. The natives showed their seriousness when Ranchhodlal Chhotalal started manufacture of glass vessels and lamp chimneys by employing European techniques used in glass making. He hired a skilled European who was expert in glass making. On the recommendation of the expert, necessary machines were procured from England.[117]

R. B. Ranchodlal Chotalal with the help of others started the Gujarat Coal & Iron Company Limited in 1884 to make an inventory of the iron ores in Panch Mahals and wanted a monopoly for the British government for fifteen years. The proposal was refused by the government.[118]

Liquor

Parsi distillers of Surat manufactured fine *mahua* based liquor which were flavoured such delicious as Mozambique lemons, pineapples, mangoes, *falsa* fruits, roses, jasmine, *mogra* flowers, cardamoms, currants and aniseed.[119] In some cases they allowed these drinks to mature for over forty years before consumption.[120]

After the Distillery Act of 1878, distilleries were established in various *talukas* of Surat and soon pressure was brought to adopt this system by the princely states.[121] By 1888, Navsari *taluka* of Baroda State and the states of Sachin, Bansda, Dharampur, Surgana and Rajpipla were all covered by central distilleries.[122] Some Parsis were allowed to operate distillery in Surat and they made both the renowned *Surti masala daru* as well as cheap unspiced *daru* for mass consumption. Pritchard, the first *Abkari* Commissioner for Bombay Presidency gave monopoly in liquor manufactured to a well-known Parsi Dababhai Dubash (held monopoly in liquor for

[117] E. Maconochie (1895), *A Monograph on the Pottery and Glass Ware of the Bombay Presidency*, 8-9.
[118] Neera Desai (1978), *Social Change in Gujarat*, 209.
[119] David Hardiman (2006), *Histories for the Subordinated*, 189.
[120] *Ibid*.
[121] *Ibid.*, 204.
[122] *Ibid*.

Poona, a coal mafia and dockyard contractor for Bombay) for Surat on contract basis for three years. Opposition came from Parsis community because of destruction of *Surti masala daru* which was banned by government and also because Dubash and Company liquor tasted bad, sugary and weak. Displaced local manufactured formed a company and brought up all of the liquor farms of Navsari *taluka* of Baroda State. They proceeded to sell cheap liquor at shops along the border with Surat, thus destroy the trade of the Surat monopolist. As the two areas were much intermingled, this strategy proved extremely effective. Dubash & Co. had to lower their prices and finally ended in loss.[123]

Navigation

According to Satpal Sangwan: "The characteristic British policy was not to encourage technological development, but to increase the productive resources of the country through the agency of imported technology. Whatever information Indians gathered regarding the making of new descriptions of technology was, therefore, a result of their quest for it".[124] In the Bombay Dockyard, the Parsi shipbuilders launched their first steam vessel, the High Lindsay followed by many more. Even Parsi shipbuilders Jamsetji Bomanji sent his son Jahangir and nephew Hirjibhoy Merwanji to England for the purpose of receiving instruction in naval architecture.[125]

The Britishers were impressed with the skills of Indian ship-carpenters and employed one Khurshedji, a Parsi, as their chief carpenter at Surat in 1672, to advice on shipbuilding.[126]

The superiority of Indian-built ship was initially not recognised by the Britishers. But natives excelled in terms of ship construction with traditional method. The British did not accept this fact for a long time. According to them, it was not the skills of the ship builders but the excellent quality of Indian woods which made the

[123] *Ibid.*, 204-06.
[124] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 127.
[125] *Ibid*.
[126] Satpal Sangwan (1995), "The Sinking Ships: Colonial Policy and Decline of Indian Shipping, 1735-1835", 139.

vessel long lasting.[127] Over the period, government was forced to accept the skills of Indian ship-carpenters and started employing local ship makers.[128] One such example was of one Khurshedji, a Parsi, as their chief carpenter at Surat in 1672, to advice on shipbuilding.[129] Over the period of time, number of Indian ship makers was employed. In the western India and especially at Surat, the Parsis especially Wadia family played very significant role. They constructed a good number of vessels for the British Government and were highly liked. Even some of them received high technical education in ship building abroad.

Steam navigation was successfully launched in India because of its advantages regarding movement of troops with heavy arsenals, trading activity and transfer of treasury from time to time.[130] It was a safer mode.[131] Introduction of steam ship totally gave setback to the traditional shipping in India is largely true, but the process of its decline was not very fast. Natives still had confidence with Indian ships at least in small coastal regions.[132]

The discussions carried in this chapter offers reasons for the acceptance of the imported European technology and at the same its rejection as per the prevailing conditions. To offer some simple generalisation about its acceptance / rejection will limit the assimilation of foreign technology into *Gujarati* society. A number of factors were at stake for its expansion or limitation in British Gujarat. Only those imported technologies were accepted which were able to adjust and fulfilled the local demands; could be procured easily and within the reach of the cultivators. The rejection of some of these technologies were owing to its cost factor, absence of expertise help and complete threat to the existing traditional industries. It is also observed that both natives and in some cases The British authorities for the successful dissemination of imported technology into the society. Natives were eager

[127] *Ibid.*, 80-81.
[128] Satpal Sangwan (1995), "The Sinking Ships: Colonial Policy and Decline of Indian Shipping, 1735-1835", 139.
[129] *Ibid*.
[130] Satpal Sangwan (1991), *Science, Technology and Colonisation: An Indian Experience, 1757-1857*, 79-80.
[131] *Ibid.*, 80-81.
[132] *Ibid*., 81-82.

to accept and implement imported knowledge and sometimes introduced alien skills even without the help of the British government.