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Mewar University Knowledge to Wisdom



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## Journal of Indian Research

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### CHAIRPERSON'S MESSAGE

Due to increasing use of the Internet, the whole world has turned into a global village. Digital technology has brought unprecedented changes in the worldwide communication revolution. There is immense potential inherent in online and digital communication medium; it can prove quite useful in education. Education is knowledge gained through a systematic approach in schools, college or university and digital technology helps in disseminating structured and systematic knowledge simultaneously at a large scale.

Information and communication technologies (ICT), are used to transmit, store, create, display, share or exchange information by electronic means. It support, enhance, and optimize the delivery of information. In education, ICT adds value to teaching and learning, by enhancing the effectiveness of learning. It added a dimension to learning that was not previously available. Nowadays, technology has impacted almost every aspect of life as well as education. With the help of Internet and the ubiquity of smart devices that can connect to it, a new age of anytime anywhere education is dawning. Technology is an important tool that can transform education sector in many ways, from making it easier for teachers to create instructional materials to enabling new ways for people to learn and work together.

For improving the quality of education, it is necessary to make use of efficient technology in an institution. This will open up more opportunities for the teachers and students as well. Our objective at Mewar University is to offer a conducive environment for pursuing research and vocational studies with a market-driven orientation. I wish all the best to research scholars and their guides of Mewar University. Let they continue to pursue research with same grit and determination that they have shown till now.

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Dr. Ashok Kumar Gadiya

### EDITORIAL

Lof world's livestock and 30 % of cattle population. With approximately 2.4 % of the world's livestock and 30 % of cattle population. With approximately 2.4 % of the world's land area, there is immense pressure on maintaining health of land. Sustainable land management practises are required for growing demand of protein-rich diet, food grains and feed for livestock. A combination of all such factors causes land degradation when there is marked reduction or loss of the biological or economic productivity. The official estimate of Wasteland in India, as per the National Remote Sensing Centre (NRSC), Hyderabad is 68.35 million hectare i.e. approximately 21% of the Total geographical Area (TGA).

Thus on one hand health and productivity of land resources are declining, on the other hand demand for land resources is increasing. The United Nations(UN) has come up with the goal of Land Degradation Neutrality (LDN) by 2030 AD under which land-based natural capital and its ecosystem populated by beneficial microorganism like nitrogen- fixing bacteria, and mycorrhizal fungi in soil are to be maintained and enhanced. To maintain health of land is a complex mechanism. There is requirement of soil moisture, decomposer fungi, nitrogen –fixing bacteria, macronutrients and micronutrients.

Soil Nitrogen in India is one of the lowest and below the global average. Nitrogen is required for manufacture of proteins and enzymes, nucleic acid and chlorophyll in plants. Without appropriate amount of Nitrogen, naturally the productivity of the farms goes down. Fertilizer load further complicates the biome populated by microorganism. Similarly, the food demand necessitates that India opts for multi-cropping. But, when we grow more crop, nutrients like Potassium is further removed from soil. This goes critically low when multi-crop intensity increases. It is Potassium that helps plants in regulation of water loss. Without sufficient amount of Potassium, the adaptation of plants to stress being caused by climate change becomes difficult. When we have a poor sub-surface ecosystem of microorganism, such deficiency becomes rampant. In Bihar, though soil is alluvial, there is greater micronutrient deficiency. This is one of the major reasons for low yield in Indian farms.

Once soil fertility goes down, the land degradation follows. Droughts lead to land degradation as microbial world depletes in the absence of moisture, and soil gets prone to erosion by both water and wind, two major causes identified for land degradation in India. The role of underground microbial world through decomposition keeps the forest and climate cycle healthy. The soil organicity cannot be sustained when there is loss of soil moisture since microbes cannot multiply in the absence of moisture.

Though, we think these are newer problems to our complex world. But, the prototype of the issues and their apt solution can also be found in our past.

Dr. Krishna Kumar Mandal from TM Bhagalpur University has contributed a long essay in the current issue *"Patterns of Agricultural Production in Early Historic India (c.* 600 BC to 200 BC)", where he discusses how in pre-Mauryan Magadha, the issue of irrigating fields,

fertility ,crop-yield, new technology attracted attention of the best of the thinkers and the philosophers. Agriculture sciences were treated at par with the highest of knowledge.

Dr. Mandal writes that the *varta*, which broadly comprised the occupations of agriculture, cattle breeding and trade, was a source of grains, cattle, gold, forest produce, etc. That the *varta* was recognized as a prominent element of State is evident from the fact that it was held on par with the triple *Vedas* and the *Dandaniti* in conjunction with which it generally appears. Kautilya made division of land on different grounds; region not depending on rainfall for water, called *adevamatrika*, were valued more than areas dependent on rain water cultivation. The *adevamatrika* land with a perennial source of water supply like river yielded abundant crops and was, therefore, preferred.<sup>1</sup> Further on a quantitative scale of rainfall the areas which depended on rain for agriculture were classified under the head of *jangala* (dry) and *anupa* (wet) – the areas with sixteen *dronas* of rainfall were called *jangala* and the areas with twenty-four dronas of rainfall were called *anupa*. A further grading of lands was made from the point of view of their suitability to different crops and humidity and water content. The *Arthasastra* divided cultivable lands into the following types *sthala* (dry lands), *kedara* (marshy lands), *sanda* (vegetable gardens) and *vata* (flower gardens and fruit orchards, sometimes specified separately as *puspa vata* and *phala vata*).

Further in the paper, Dr. Mandal elaborates how the Buddhist texts refer to the builders of the water conducting canals (*udakamhi nayanti nettike*) and describe measures for regulating the inlet of water to *khetta* (fields) after sowing. The *khettas* of Magadha were intersected by the network of canals and curvilinear which marked the boundaries of arable plots and which resembled a patchwork robe (*chivara*) such as a prescribed by Buddha as a pattern for the order being the least covetable things. The *Mahavastu* lists the duties of an agriculturist which include control of land irrigation. Further the period came to have an agricultural calendar based on six seasons and 27 *naksatras* or constellations, which though already known to later Vedic texts, became well established in the *Grhyasutra*; different seasons and *naksatras* were prescribed for sowing different grains and performing different agricultural festivals. Kautilya generally uses the term *setu* or *setubandha* (i.e. reservoir build by putting dams on streams) in general sense of an irrigation work.

At this juncture, when climate change is causing new problems to our farmlands, it is necessary to dive deep into traditional wisdom and find out the time-tested solution for finding climate-resilient smart agriculture. Researchers of ecology, agriculture sciences and ancient history have to engage in dialogue through platforms like research journals and multidisciplinary conferences. Journal of Indian Research has been persistent with such dialogue.

**Niraj Kumar** Honorary Editor

#### HISTORY

### PATTERNS OF AGRICULTURAL PRODUCTION IN EARLY HISTORIC INDIA (C. 600 BC TO 200 BC)

### Dr. Krishna Kumar Mandal\*

#### ABSTRACT

Buddha favoured agriculture as against pastoralism. He was reflecting the new values of the pre-Mauryan period. By his time, plough cultivation spread across the middle Gangetic basin. This paper explores the semantic usage about the rising forces of production, agricultural technology and agricultural methods and produce in early historic India.

Keywords: Arthasastra, Ganga, irrigation work, Jataka, Kautilya, Mauryan, milch animal, Pali texts, peasant, rainfall, sesame.

#### INTRODUCTION

The peasant mode of production was the result of the surplus produced by the landless agrarian class. The point to ponder over is: What was the nature of the forces of production that generated this quantum of surplus? Land and water are the principal factors of production combined in the process of production with seeds and other inputs using various 'instruments' including tools and livestock. To explore the forces of production or agricultural technology, agricultural methods and produce in the context of early historic India, one needs to undertake a terminological/semantic analysis and study of phrases and perception of different means of verbal and non-verbal communications which happened in everyday life of peasants in which they worked and conceptualized the world.

In the pre-Mauryan period, land, which had become the chief means of subsistence of the people, seems mostly in the possession of peasant families. The *Suttanipata*<sup>1</sup> speaks of possessions as comprising sons (*putta*), fields (*khetta*) and property (*vatthu*). For fixing individual possession of fields and assessing taxes, the knowledge of measurement was necessary; methods of calculating the areas of the circle, rectangle, etc., or the method of converting circles into squares though prescribed in the religious context in *Sulvasutram* may have arisen in response to the needs of field agriculture. Agriculture in general had become so important, that the special

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attention was given to the types of fields in early Buddhist teachings. One sutta classifies the field as (i) best, (ii) middling, and (iii) inferior, forested and infertile. The monks are compared to the best field, the lay devotees to the middling, and the *sramanas*, brahmanas and ascetics of other religious persuasions to the field of bad quality.<sup>2</sup> The Khetta Sutta<sup>3</sup> speaks of eight types of fields which denote varying patterns of yield. These are undulating, rocky and beffly, catfish; without depth of filth, without water outlet, without inlet, without any water course and without types. In such fields sowing seeds is a kind of waste. On the other hand opposite qualities are found in eight good types of fields in which seeds fructify on a large scale.<sup>4</sup> The sramanas and Brahmins, who follow false doctrine and have wrong sources of livelihood, are compared to the bad eight types, and those who observe the right type of doctrine and adopt right sources of livelihood, are compared to the good eight types of fields. Panini categories land as arable (*halva*), pasture (*gochara*) and waste land (*usara*).<sup>5</sup> The frequent use of agricultural similes reinforce the importance of agriculture in society.<sup>6</sup> Many of the Vinava rules themselves relate to crops, and the institution of *vassatvasa* or the rain retreat was permitted by the Buddha when people complained against the damage caused to the new crops by the *bhikhus*' incessant touring in the rainy season.<sup>7</sup> A passage in the Samvutta Nikava reflects Buddha's recognition of the importance of agriculture. In a conversation between a *deva* (deity) and the Buddha, the deva upholds the traditional view and remarks on the significance of cattle. In his reply, Buddha favours agriculture as against pastoralism, and in this he was clearly reflecting the new values of the period.<sup>8</sup> Consequently, the possession of fields became an extremely valuable asset and is frequently reflected in the Buddhist texts.<sup>9</sup> The varta, which broadly comprised the occupations of agriculture, cattle breeding and trade,<sup>10</sup> was a source of grains, cattle, gold, forest produce, etc. That the varta was recognized as a prominent element of state is evident from the fact that it was held on par with the triple Vedas and the Dandaniti in conjunction with which it generally appears.<sup>11</sup> Kautilya made division of land on different grounds; region not depending on rainfall for water, called *adevamatrika*, were valued more than areas dependent on rain water cultivation (5.2.2; 6.1.8). The *adevamatrika* land with a perennial source of water supply like river yielded abundant crops<sup>12</sup> and was, therefore, preferred.<sup>13</sup> Further on a quantitative scale of rainfall the areas which depended on rain for agriculture were classified under the head of *jangala* (dry) and anupa (wet) – the areas with sixteen dronas of rainfall<sup>14</sup> were called jangala<sup>15</sup> and the areas with twenty-four dronas of rainfall were called *anupa*.<sup>16</sup> Jangala obviously did not mean arid areas.<sup>17</sup> A further grading of lands was made from the point of view of their suitability to different crops and humidity and water content. The Arthasastra divided cultivable lands into the following types sthala (dry lands), kedara (marshy lands), sanda (vegetable gardens) and vata (flower gardens and fruit orchards, sometimes specified separately as *puspa vata* and *phala vata*).<sup>18</sup> Normally sthala and kedara are contrasted but at some places sthala has been contrasted with anupa.<sup>19</sup> Anupa, therefore, meant both a wetfield and an area with heavy rainfall.<sup>20</sup>

Another kind of division was made between the *sthala* and *audaka* (land abounding in water).<sup>21</sup> A small tract of *audaka* land was thought better than large *sthala* land because of the definiteness of produce. *Audaka* land, therefore, seems to have been the same as *adevamartika* land. *Sthala*, which probably was used as an interchangeable term with *jangala*, was suitable for crops that needed a small amount of rain for ripening (*sasyamlpavarsa pakam*) and if proper crop was sown could yield a large harvest.<sup>22</sup> The term *anupa* not only meant an area

with high rainfall,<sup>23</sup> it was also used for wet and marshy land or as a synonym for *kedara*. *Kedara*, however, did not mean only a land which got sufficient water through irrigation, for *kedara* is mentioned in the list of revenue items classified under the head *setu*.<sup>24</sup> *Audaka*, *anupa* or *kedara* lands, thus, were suitable for grains (*dhanya*).<sup>25</sup> Probably it was in these lands that crop like *Sali* and *vrihi* were grown.<sup>26</sup> Muddy land, land with stone, arid saline land (*usara*) were poorly thought of.<sup>27</sup> All these are suggestive of land as a basic means of production.

The pre-Mauryan period suggests the currency of plough cultivation in the middle Gangetic basin is indicated by the use of the Pali term *nangala* (plough) in several forms.<sup>28</sup> The Suttanipata mentions a village called Icchanangala in Magadha.<sup>29</sup> Panini uses the term hala for plough.<sup>30</sup> He has referred to three categories of farmers, designating them on the basis of the quality of the plough which they used. They are as follows: (i) those who did not possess their own plough (ahali)<sup>31</sup> (ii) those who used a superior plough (*suhalah*), and (iii) those using a bad plough (durhalah)<sup>32</sup>; thus the plough was a sign of prosperity.<sup>33</sup> He also mentions double and triple ploughing of land. Elaborate details of agricultural operation appear in Panini<sup>34</sup> and various types of sacrifices for promoting agriculture and husbandry are provided in *Grhvasutras*.<sup>35</sup> A story narrates the king's role among the Sakyas in the annual ploughing festival called Vappa mangala. According to the Nidana Katha, the king wielding a golden plough and 107 of his councillor wielding silver ploughs participated in a ritual ploughing while their dasakammakaras enjoyed the festival, wearing new clothes and garlands.<sup>36</sup> All these evidences show the burgeoning agriculture in the Pre-Maurya period. The term ayanangala or ironploughshare is mentioned in a later Pali text.<sup>37</sup> The Kasibharadvajasutta of Suttanipata gives the analogy of ploughshares which having become heated during the day, hisses and smoke when it plunged into water.<sup>38</sup> The analogy is repeated in the Mahavagga.<sup>39</sup> An early Pali text and Panini speak of avoghana which is either a hammer or an anvil. Iron ploughshares called avovikara kusi appears in Panini.<sup>40</sup> It suggests the use of iron-ploughshares in agriculture.<sup>41</sup> Undoubtedly its use in agriculture becomes fairly certain. The Jakhera ploughshare of c. 500 BC,<sup>42</sup> the two ploughshares from middle NBP phase, one each from Kausambi<sup>43</sup> and Atranjikhera<sup>44</sup> and one from Ganwaria<sup>45</sup> illustrate the changing scenario. Iron axes, sickles and chisels, though not profuse, keep on appearing in the middle NBP context. The situation, however, does not warrant any conclusion in favour of an "unprecedented growth of the crafts, industries and some occupation".<sup>46</sup> It is pertinent to note that most of the basis in terms of a parallel use pattern for the contemporary middle Ganga Valley,<sup>47</sup> especially for the area of modern Bihar, does not seem sound.<sup>48</sup> The ecological interpretation behind the absence of wrought iron objects seems plaughible.<sup>49</sup> The analysis of the iron-ore relationship in the context of tools discovered from Rajghat indicates the use of Singhbhum and Mayurbhanj ores at the site.<sup>50</sup> This, along with the known technology of wrought iron and use of bellows<sup>51</sup> proved to be a decisive factor in the dissemination of this technology in the Ganga valley. The most significant development of the period is the standardization of cultural elements over a vast geographical area. Thus the NBP finds of the pre-Mauryan times have been reported from all over the Ganga valley as well as the region of Malwa.52 The use of iron tools helped the expansion of agriculture, a development illustrated by a significant spurt in the number of NBP settlements primarily in eastern U.P. and Bihar.<sup>53</sup> The use of iron ploughshare facilitated agriculture which was further boosted by the beginning of the practice of transplantation of paddy.

Although the expansion and refinement of iron technology had been considerable since 500 BC, it was not until the second half of the 4<sup>th</sup> century BC that its full impact was felt on society. It is with the arrival of the Maurya on the scene that the dominant economic and political institutions came to formalized. The period witnessed further strengthening of iron technology, both spatially and technically. A study of the NBP sites suggests that many new regions, where the precise beginning of the Iron Age was uncertain till the pre-Mauryan times, now came to acquire its developed traits.<sup>54</sup> Both at Hastinapur<sup>55</sup> and Sravasti,<sup>56</sup> this phase is richer in iron objects compared to the preceding NBP phase. Similar is the case of Kausambi.<sup>57</sup> Out of eleven types of iron arrow-heads and five types of spears and javelins reported at the site, as eight types of the former and all the five types of latter occur throughout this phase.<sup>58</sup> This pattern is repeated at a number of sites.<sup>59</sup> At the second set of sites which have recorded cultural antecedents- Ropar, Sonepur and Sohagaura, for instance, iron appears in the 4<sup>th</sup> century BC.<sup>60</sup> A third set of sites, where this phase of the NBP is not preceded by any cultural phase, illustrate the physical and spatial progress of iron more poignantly. Excavations at Taxila underline this pattern of technological expansion. In fact as one moves towards the Mauryan times the sites start yielding a large number of iron objects, <sup>61</sup> a fact that gives strength to the suggestion that the Iron Age in India almost reaches a stage of culmination in the 3<sup>rd</sup> century BC. Iron objects are forthcoming, for the first time, from Sisupalgarh, Nasik and a host of other sites, in Maharashtra and Central India.<sup>62</sup> Except a few sites, the settlements of the period are decidedly marked by a profusion of iron objects. Iron-yielding sites even in the south, especially in Karnataka and Andhra, suddenly increase in number in the 4<sup>th</sup>, 3<sup>rd</sup> and  $2^{nd}$  centuries BC, but it has been suggested that this had nothing to do with the northern development.<sup>63</sup> It is true that the direct linkage between the two cannot be established, but it is difficult to ignore the occurrence of some of the typical idioms of Mauryan culture in the region.64

A greater exploitation of iron mines fulfilled the growing demand for the metal on the one hand, and helped its further spread on the other. The textual evidence is very specific on the point.<sup>65</sup> The Mauryan state exercised a monopoly over mines and trade in mineral products. Kautilya, realizing the importance of mining, provides for an Akaradhyaksa (Superintendent of Mines), a Khanavadhvaksa (Superintendent of digging), a Laksanadhvaksa (Superintendent of Elements) as well as a Lohadhvaksa (Superintendent of Iron working). The location of numerous small heaps of iron slags scattered all over the iron belt in south Bihar<sup>66</sup> suggests substantial iron working. The discovery of a number of pits, containing charcoal, iron slags and sand, from period I at Saradkel at Ranchi<sup>67</sup> lends credence to this view. The excavator refers to these pits an iron smelting ovens.<sup>68</sup> This was possibly a factory site. A better organization of iron working, therefore, seems to have become the hallmark of the period. Kautilya was so conscious of the importance of metals and mining that he went to the extent of asserting that mining was the source of all power.<sup>69</sup> This concern of the state and the growing social demands on iron helped the refinement of its technique. Now we have better evidence, both in terms of quality and quantity, for smelting and forging of iron objects. The excavation at Dhatwa bears out this development. The smelters here succeeded in extracting 99.76% pure iron. They also devised the technique of manufacturing hard implements, like hoe, in two stages involving the process of forging welding.<sup>70</sup> The best set of evidence of smelting and manufacturing of iron objects is

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forthcoming from Ujjain where lime, representing calcium compounds, was being used as flux. Analysing the archaeological data, N. R. Banerjee writes, "The remains of a forge with groove for the introduction of the working end (or nozzle) of blower or bellows, an impoverished stand made from the sturdy and large neck of an broken vessel to support a water jar to store water for quenching, a small or miniature jar to collect small quantities of water according to necessity, and a shallow but large enough bowl to contain water near at hand for quenching help to reconstruct the process of a blacksmith's working. The use of an anvil also of iron and iron rods like pincers for handling the red-hot bar or tool, is clearly indicated. The iron nail and chisel lying near the forge, which is lined with bricks and clay burnt hard, and contains ash and charcoal, suggest the variety of objects produced, sharpened or remade at the forge. This method is even mow in vogue and would by itself indicate an advance stage of development of the process of iron working with a long background."<sup>71</sup> Thus, the post- c. 350 BC period has two dimensions of the social implications of iron technology manifestation of its impact on society and furtherance of this trend through technological expansion. The material *milieu* of the time was essentially a culmination of the socio-economic processes inaugurated during the later Vedic times, which led to the transition from a pastoral/agrarian economy to an established and full fledged peasant economy.

The Jatakas manifest this emerging scenario. One of the Jatakas gives a graphic symbolic description of the plough by saying that snakes are like the shafts of plough,<sup>72</sup> elephant's trunk and tusks are like the shafts of plough, sugarcane is like the shaft of plough. These perceptions represent a bundle of perceived features in the form of composite units. It is closely associated with the extent of its integration in the society which it seeks to express.<sup>73</sup> It is, in fact, an awareness and understanding of a relation between forms.<sup>74</sup> The dominant constituent of the knowledge prevailing at the level of 'peasantry is localized knowledge',<sup>75</sup> of which proverbs, that is, 'rustic wisdom', are a significant part.<sup>76</sup> A proverb is an abbreviated traditional instruction statement,<sup>77</sup> which comes 'with the wisdom of the age', what is proverbial has been established for a long time.<sup>78</sup> While a ploughman was ploughing, his ox was laid down being struck by the ploughshares.<sup>79</sup> The plough with iron-ploughshares furrows deep and wide and symbolized golbins between its jaws. These references suggest that the wooden-plough and plough with iron ploughshare were superior in terms of technology and productivity. Both were used according to the texture of the soil. The sandy-loam soil is easier to cultivate with wooden plough, the clay-loam soil requires iron ploughshare. The Jatakas prescribe for the topography of eastern U. P. and Bihar, i.e. Middle Gangetic Valley. The large amount of clay in soil makes it sticky when wet and hard when dry.<sup>80</sup> numerous references to rice (sali) and sugarcane in the Jatakas suggest that deep cultivation was possible by the iron ploughshare. The Arthasastra<sup>81</sup> mentions double and triple ploughing of land. To make the ploughing deeper several oxen were harnessed (sometimes as many as 24).

The use of iron ploughshare was supplemented by that of hoe<sup>82</sup> and spade<sup>83</sup> (*kuddala*). Panini suggests that sickles (*datra lavitra*), hoes (*stambaghna*) and spades (*khanitra, akhana*)<sup>84</sup> were used in farming. Those tools have been excavated in multi-layer settlements dated to the *c*.600-200 BC. A *Jataka* tells us that there was a dire need of an axe, a spade, an iron-staff, a peg, and a three-pronged iron fork. A person cut the jungle of grass with a sickle

and cleared bamboos with his instrument, felled the trees with an axe and pierced it with an auger.<sup>85</sup> It suggests the clearance of the jungle and foundation of settlement and introduction of agriculture. The process of cutting and digging out roots is clearly indicated by the frequent use of similies.<sup>86</sup> A *Jataka* refers to the smith's villages of a thousand houses. People came from villages around to have razors, axes and ploughshares.<sup>87</sup> Other *Jatakas* refer to blacksmiths and carpenters skilled in their crafts of making razors, adzes, spades, hoes and many other tools.<sup>88</sup> It, in fact, indicates extensive use of iron of fabrication of agricultural implements.

The paddy transplantation is a major form of production during this period. The term for planting samplings from paddy seeds is mentioned first in early Pali text.<sup>89</sup> We hear of *ropana* and ropeti. It is correctly suggested that the Vedic vrihi was grown without transplanting and sali was grown by means of transplantation.<sup>90</sup> For producing such paddy it became necessary to plough the hard alluvial soil and prepare the ground for planting. Such plots of land, therefore, came to be known as *kedara*, from which the Hindi term *kevari* is derived.<sup>91</sup> The process of paddy transplantation is vividly described in the Jnatadharmakatha. We learn that agricultural labours (kula gharapurise)92 attached to the household of Rohini,93 one of the four daughter-inlaw of a rich merchant called Dhana, saw five unbroken paddy grains on a small well prepared bed.94 Twice and three times they transplant the seedlings.95 It may be added that the practice of removing the transplanted paddy plants from the thickly growing fields and replanting them in another field is prevalent in several districts of north Bihar. It is practiced in areas covered with sheets of water. As the water recedes and the land becomes plantable, paddy plants from the congested portions of the first transplantation are weeded out and replanted in other fields. The Jnatadharmakatha shows familiarity with Anga, Magadha and Mithila. Rajagriha is the scene of the story referring to paddy transplantation, but the fact also mentions Champa and Mithila. However uproofing the twice transplanted plants and replanting them a third time is not so common. A second transplantation gives a higher yield, and a third still higher. R.S. Sharma<sup>96</sup> is absolutely right "about the prevalence of paddy transplantation in the middle Gangetic zone in the age of Buddha."

The *Arthasastra* also mentions that *audaka, anupa* and *kedara* lands were suitable for grains (*dhanya*).<sup>97</sup> Probably it was in these lands that crops like *sali* and *vrihi* were grown.<sup>98</sup> *Kedara* is mentioned in the list of revenue items classified under the head *setu*.<sup>99</sup> While discussing the nature of different crops Kautilya<sup>100</sup> informs that rice crops and the like are the best (*jyestha* i.e. to grow). According to Aristobulus, rice was sown in beds and the plant used to be four cubits in height not only having many ears but also yielding much grain.<sup>101</sup> The Mahasthan inscription alludes to the sowing of paddy in Pundranagar.<sup>102</sup> The *Mahavastu* suggests that in Vaisali twenty five and more kinds of rice were given to the Exalted One (Lord Buddha) and the community of his disciples.<sup>103</sup> Patanjali praises the *sali* rice grown in Magadha<sup>104</sup> and refers to bumper harvest of *vrihi* rice.<sup>105</sup> The *Jatakas* contain approximately seventy references to rice and five times these are associated with rice gruel. A *Jataka* refers to different types of rice (*sali*).<sup>106</sup> *Sali* has been categorized as best, inferior,<sup>107</sup> wild,<sup>108</sup> and red<sup>-109</sup> It dominated the dietary pattern of the people as rice powder, boiled rice, rice-gruel, parched rice and rice broth to drink.<sup>110</sup> It is also a medium of exchange.<sup>111</sup>

Rice was the medium of tax <sup>112</sup> and became a status symbol.<sup>113</sup> It was grown by means

of transplantation. The *Salikedara Jataka* suggests the preparation of ground for planting. Mithila has been frequently referred to in the *Jatakas*. The words in Maithili language like *birar, araha, kadawa, rapani* and *kadwapakhar* are suggestive of paddy cultivation. This process involves intensive labour consumption. A definite relationship between rice growing areas and the incidence of high fertility has been suggested since the consumption of rice gruel allows children to be weaned away from mother's milk earlier so that the mother becomes ready to conceive a grain.<sup>114</sup> Thus rice cultivation virtually led to demographic revolution which strengthened the settlements and resource base.

The early Pali texts contain numerous references to cow-killing. In the Majihima Nikaya similies speaking of skilled cow-butchers or apprentices to those butchers engaged in their jobs on the cross roads are repeatedly used.<sup>115</sup> The Suttanipata indicates the comparison of death taking toll of living beings with to cows meant for killing.<sup>116</sup> The excavation at Atranjikhera suggests this practice.<sup>117</sup> Now with the society moving into a phase analogous to the K-strategists of ecology, people would have required a new belief system, stressing more careful and sustainable pattern of resource. Such a belief system appealed to the agricultural component of the population but was opposed by the Brahmans, the votaries of the vaina system. The Buddhists responded to this and protested against the hegemony of brahmanas, the wasteful burning of endless qualities of clarified butter and wood, and the slaughter of animals in sacrificial rituals.<sup>118</sup> In this sense ideology should be interpreted as technology.<sup>119</sup> The Suttanipata suggests that the cattle are givers of food, strength, beauty and happiness.<sup>120</sup> It is in true with the contemporary situation in China. In the Shung Dynasty (c. 1600-1000 BC) oxen were used as food or sacrificial offerings. They were rarely used for tillage. To comply with the needs of oxen for tillage based on iron plough the raising of oxen greatly developed during the period from Warring kingdom (475-221 BC) to the Han dynasty (206 BC to 207 AD), Si-Man-gian records, "The people who worked on raising oxen, pigs, sheep or horses could get richer."<sup>121</sup> It is stated a person who lives on cattle rearing should be identified as a cultivator.<sup>122</sup> The Jatakas do suggest this scenario. The changing atmosphere is perceived. More oxen had been used as draught power from agricultural activities.<sup>123</sup> Many Jatakas refer to anti-sacrifice<sup>124</sup> and anti-slaughter<sup>125</sup> attitude and attach it with transmigration. A Jataka does state that a person who lives on cattle rearing should be identified as a cultivator.<sup>126</sup> Cattle wealth had to be preserved for agriculture but dietary needs had to be met. In a Jataka pork was preferred to beef.<sup>127</sup> The rice-economy was supplemented by domestication. A Jataka<sup>128</sup> refers to *hattipala*, assapala, gopala and ajapala. Thus the protection to cattle has undoubtedly been important in shaping the practices of mixed agriculture and animal husbandry so characteristic of India.

The state's concern for protecting and supporting the pattern of agrarian expansion, illustrated by Asoka's repeated exhortations in favour of non-injury of animals,<sup>129</sup> was an essential component of the system. Kautilya too is familiar with this issue. Almost echoing the same idea he states, "Cattle such as calf, a bull or a milch cow shall not be slaughtered."<sup>130</sup> Asoka's edict shows that the state paid much attention to promoting livestock-breading. Along with such major officials as the *Dhammamahamatras*, they mention special officials supervising pastures- *Vrajabhumikas*.<sup>131</sup> Kautilya devotes one chapter of his treatise<sup>132</sup> to a cattle supervisor (*goadhyaksa*) and gives

interesting data on the strict system of checking both the cattle and the produce on the royal cattle breeding farms. The supervisors were supposed to know the exact number of herds, the number of lost and dead animals and the produced quantity of milk and butter.<sup>133</sup> Kautilya prescribes that killing or stealing cattle or even instigating such killing was liable to capital punishment.<sup>134</sup>

The early Pali texts suggest that the rain retreat was permitted by the Buddha when people complained against the damage caused to the new crops by the *bhikku's* incessant touring in the rainy season.<sup>135</sup> It indicates the importance of rainy season or rain. Kautilya accepts this fact more clearly. For a good crop, however, proper distribution of rainfall was as important as the sufficiency of rain, rain over the monsoon months with intervening periods of sunshine and moist wind were necessary. "One-third of the (annual) rainfall in the first and the last month (together), two-third in the intervening two months" was considered the ideal distribution.<sup>136</sup> On a quantitative scale of rainfall, the areas which depended on rain for agriculture were classified under the heads : jangala (dry) and anupa (wet), the areas with sixteen dronas of annual rainfall<sup>137</sup> were called *jangala*<sup>138</sup> and the areas with twenty-four *dronas* of rainfall were called *anupa*.<sup>139</sup> Jangala, which obviously did not mean arid areas, was suitable for crops that needed a small amount of rain for ripening (sanyamalpayarsapakam) and if proper crop was sown could yield a large harvest.<sup>140</sup> The *anup* land with high rainfall<sup>141</sup> was suitable for grains (dhanya)<sup>142</sup> on which crops like sali and vrihi were grown.<sup>143</sup> All these evidences suggest rainfall as a natural instrument of production, so that "individuals are subservient to Nature". Nature is the source of necessary material which on being filtered through human labour forms the instrument of production and produces people with control over natural in labour forms the instrument of production.<sup>144</sup> Marx and Engels differentiated these instruments of production as those "created by civilization."<sup>145</sup> The Jatakas suggest that the failure or the success of the crops in the irrigated tracts was decided to a great extent by rainfall.<sup>146</sup> In fact crops perished due to frequent droughts.<sup>147</sup> Rainfall, therefore, had prominent role in the paddy cultivation. Pavarna festival<sup>148</sup> and chanting of rainsongs<sup>149</sup> indicate its importance among people. Transplanting is water consuming technique but sowing is not. A Jataka hints that due to deficiency in rainfall when peasants were unable to live they resorted to robbery.<sup>150</sup> The Kasi famine was so severe that even crows had to quit the land for men had no food to spare.<sup>151</sup> It suggests that the time structure of the crop, as it evolved in consonance with the rainy season, was such that there was a considerable differences between the production and working period. This condition arose from utilizing rainfall as a natural instrument of production in conjunction with the poor economic condition of peasantry. In the Gahapati Jataka, famine-stricken villagers obtained ox for loan from the *bhojaka* on condition of repaying in kind from the next harvest.<sup>152</sup> Another Jataka tells us that after rains a ploughman begged the loan of two oxen and ploughed his field with them.<sup>153</sup> One Jataka tells that the kutumbika went to villages to collect debts.<sup>154</sup> It suggests the pressure which drove peasants towards borrowing even for consumption and this paved the way for usury and class differentiation within peasantry.

The climatic conditions, the uneven rainfall, the violent overflows of the river in the period of monsoon, the abrupt changes of temperature, and the draught called for artificial irrigation in the pre-Mauryan time. Literary texts of this period show a knowledge of irrigation. Panini mentions a leather basket for water (*udanchana*) and the yoke (*yugavaratra*) put on oxen

drawing up water.<sup>155</sup> The Buddhist texts refer to the builders of the water conducting canals (udakamhi nayanti nettike)<sup>156</sup> and describe measures for regulating the inlet of water to khetta (fields) after sowing.<sup>157</sup> The *khettas* of Magadha were intersected by the network of canals and ridzes-rectangular and curvilinear which marked the boundaries of arable plots and which resembled a patchwork robe (chivara) such as a prescribed by Buddha as a pattern for the order being the least covetable things.<sup>158</sup> The Mahavastu lists the duties of an agriculturist which include control of land irrigation.<sup>159</sup> Further the period came to have an agricultural calendar based on six seasons and 27 naksatras or constellations, which though already known to later Vedic texts, became well established in the Grhyasutra; different seasons and naksatras were prescribed for sowing different grains and performing different agricultural festivals.<sup>160</sup> Thus during pre-Mauryan times irrigation contrivances hardly excelled, water was drawn by means of level (tulam), the bullock team (karakataka) or the wheel and axle (chakkavattakam).<sup>161</sup> Large-scale, high-cost irrigation work requiring much labour was normally carried out by the state. All free members of village communities took part in building irrigation works. Owners of both large farms and small plots were obliged to take part in the building of irrigation system. The Jatakas do indicate the system of artificial irrigation which presupposes better irrigation facilities for physical and agricultural needs. The usual means of irrigation included pools, wells and tanks. They do not provide details about the method of their construction. The canals and tanks were apparently dug by a co-operative efforts and for a co-operative use.<sup>162</sup> It indicates the growing recognition of the importance of hydraulic projects in agrarian development. A Jataka tells us that a peasant clearing his field made a little embanked square for water around a reservoir.<sup>163</sup> The Kunala Jataka<sup>164</sup> narrates how the two well-known groups, Sakyas and Koliya, constructed a dam across the river Rohini by mutual and co-operative efforts. Thus the efforts of the community, individual and the state led to agro-technological development. The Arthasastra talks about the currency of mature engineering skill. In the aryan period a dam on the Sudarsan lake was built by local governor, Pushyagupta.<sup>165</sup> The Arthasastra, which is believed to project a picture of a highly centralized state,<sup>166</sup> frequently refers to small scale irrigation works owned and organized privately. In this context it is significant to note that the Mauryan empire has been singled out by Wittfogel for maintaining a "grandiose hydraulic economy".<sup>167</sup> But the facts go contrary to his thesis. According to it, the chief means of irrigation were river (*nadi*), lake (*sara*), tank (*tadaka*), well (*kupa*), spring (*utsa*) and reservoir (adhara).<sup>168</sup> Kautilya generally uses the term setu or setubandha (i.e. reservoir build by putting dams on streams) in general sense of an irrigation work<sup>169</sup> and refers to two types of *setus*: (a) *sahodaka* – wells and tanks which could be fed by such natural sources as springs, and (b) aharayadaka - tanks and embankments where water was stored. Some historians suggest that a clear reference to canals for irrigation in the Arthasastra is found in a sutra which points out that water was set in motion by digging (khatapravrittim) from a riverdam (nadinibhandhayatana) or a tank.<sup>170</sup> But its context seems to suit more a channel from a tank or dam rather than to a canal as such. According to R.S. Sharma,<sup>171</sup> the traces of two old canals, one at Kumrahar having a length of about 450 feet,<sup>172</sup> and another at Besnagar with a limit of about 185 feet,<sup>173</sup> may have been of Mauryan origin.

The private ownership of irrigation works is evident from the fact that Kautilya considers tanks and reservoirs as items of immovable property of an individual,<sup>174</sup> and points out that an

owner may loose the ownership of his tank or irrigation work (*setubandh*) if he does not use it for five years, except in case of distress.<sup>175</sup> Kautilya also permits a person to sell or mortgage his irrigation work,<sup>176</sup> and underlying the procedure for it suggests that the owner should proclaim his intention to sell at the boundary (of the object put on sale) in the presence of the village elders, who are neighbours "declaring the price acceptable to him, and when, not objected to by anyone after three proclamation, the purchaser should be entitled to purchase it."<sup>177</sup> He further adds that if the price is increased because of competition (*spardhya*), the increased price alongwith tax should go to treasury.<sup>178</sup> It indicates that the state was more interested in the collection of tax on sale and purchase than in the construction and maintenance of the irrigation work.<sup>179</sup> The communal activity in building irrigation works is also noted by Kautilya. With regard to the settlement of the countryside, he suggests that all local people should co-operate in building dams, etc., and those who walk out of the joint venture (*sambhuyasetubandhat*) should be asked to share the expenses but should be given 'no option' of the benefits derived.<sup>180</sup> It indicates that only those who co-operated in building a dam or a tank were entitled to claim the benefit of water from it.

Kautilya mentions four different methods of "setting water into motion" for the land to be irrigated.<sup>181</sup> As the water-cess (*udakabhaga*) charged by the state varied in each case, it can be believed that the methods graded by him on the basis of their efficiency were (a) "hand moved" (hasta-pravartim), (b) "shoulder-moved" (skandha-pravartim), (c) "lifted from tanks, wells, rivers, etc." (udghatam), and (d) "machine moved" (strotayantrapravartim). "Hand-moved" obviously irrigation through manual labour, may be carrying water in pitchers from hand to hand, as suggested in the Gathasaptasati, the work of Hala, a Satavahana king.<sup>182</sup> "Shouldermoved" probably meant the use of animal power, i.e. yoking bullocks for drawing water with the help of a long rope. Udghatam might referred to the method of lifting water from tanks, wells, etc. with the help of *dhenkli*, i.e. a contrivance with a long bamboo balanced on lever, with a load on one end and a bucket with a rope on the other. The strota-vantra must have been a kind of hydraulic machine with a wheel and buckets. The origin and introduction of Persian wheel, (a wheel with chain and pots), however, is a matter of considerable debate.<sup>183</sup> The exact nature of these machines may not be known but the fact that a considerable progress was made in the technology during the Mauryan period cannot be denied. However, an important feature of this period was the permission given to the owners to rent or lease out water from tanks, ponds etc., to the needy in return for a stipulated produce.<sup>184</sup> Since only such peasants who had enough resources to mobilize men and money could own irrigation works, their control over water must have led to the establishment of some sort of exploitative relation between the rich and the poor peasants in villages.

The renewal of soil fertility took place either naturally, thanks to the climate and deposit of fertile silt in the river valley with each annual inundation, or through artificial manuring or through an admixture of both. Early Pali texts are silent on the use of manures in cultivation but the *Jatakas* refer to it. The Bodhisattva went to plough his field with his son. His son gathered rubbish and set fire to it.<sup>185</sup> It is suggestive of the use of ashes and leaf as manure. Different kinds of ash are still used in north India but particularly of cow-dung.<sup>186</sup> The *Jatakas* speak about cow-dung but do not indicate its use as manure, through the *Arthasastra* recognizes "fertilizing

qualities of cow-dung, cow-bones, fish, honey and clarified butter."<sup>187</sup> The cattle-dung and the bones and flesh of animals containing ingredients such as nitrogen, phosphorus and phosphate significantly added to the growth of crops. The first clear reference to the actual application of cow-dung to the fields is to be found in *Harsacarita* of Bana. Bana describes a cultivator driving bullock-carts filled with cow-dung and other refuse to the fields to restore its fertility.<sup>188</sup> In fact, natural deposition of silt during the river floods adequately replace soil nutrients removed by the harvest of crops to the field. As such natural formation of the soil contained nitrates and minerals transported through water; the response of the crops was naturally favourable. Thus Strabo says that after the diminution of floods, the half dried soil scratched into furrows by any common labourer brought, whatever was grown, to perfection.<sup>189</sup> In the Jatakas there is a solitary reference to grains being washed away in the rainy season but obviously to *khettas* which were not flooded, for "the corns had just sprouted" and the villagers expected a fair harvest if they could hold on for two months.<sup>190</sup> It was in appreciation of this highly fertile property of the Ganga water that the eminent hydraulic engineer. Sir William Willococks, argued so strongly in favour of shallow canals that would ensure 'overflow irrigation' carrying muddy river water into the fields.191

Before the actual sowing of the seed, the field was properly prepared for it. Sometimes, it was ploughed twice and at other times thrice.<sup>192</sup> Recurrent references to paddy and sugarcane suggest it. Kautilya also refers to the ploughing of the land several times.<sup>193</sup> The Greek writers have also written about the same process.<sup>194</sup> Before ploughing the field, the seeds (*trina*) were removed by means of stambaghna<sup>195</sup> (hala). When the ground was prepared, the next stage was the sowing of the seed.<sup>196</sup> When the grain was ripe, it was cut with a sickle (*dastra or lavitra*).<sup>197</sup> A reaper was called *lavaka*.<sup>198</sup> Probably some labourers took part in the harvesting to get some share of the produce as is the practice even today.<sup>199</sup> When the reaping process was over, the produce was piled up on a threshing floor.<sup>200</sup> The threshing floors of most of the peasants were generally close to each other and this can clearly be inferred from the word khalya.<sup>201</sup> Kautilya also prescribes the proximity of threshing floors for safety purposes.<sup>202</sup> Then came the stage of winnowing which was one by means of supra.<sup>203</sup> The winnower with the winnowing fan, scattered the grain on the threshing floor, and thereby separated the grain from the chaff.<sup>204</sup> Kautilya clearly refers to agricultural labourers employed on farms by the state and by the rich farmers. When the grain was separated from the chaff, it was collected from the threshing floor and not a single straw was left there, as it is clearly from the word sambhrta busam.<sup>205</sup> Kautilya also enjoins that even a straw should not be left in the field after the harvesting process.<sup>206</sup> It was then stored in jars.

The *Jatakas* are in tune with the emerging scenario. References to sugarcane and paddy suggest multiple ploughing so that once sown the clods must be repeatedly smashed; in order to spread out soil and its weeds must be ploughed. References say that seeds were prepared and parched in the sun.<sup>207</sup> The agriculturist sowed different kinds of grain alongwith sprinkling of water.<sup>208</sup> When crops stood thick in the field, the peasants anxious to kill the creature that devoured crops used to dig pitfalls, set traps, fix stakes and shares.<sup>209</sup> At the time of coming rains, they would hurry to the field with spade and basket in hand to bank the dykes<sup>210</sup> and the woman of the home shall make haste to carry in-door rice and crops that were spread in the sun to dry, lest the harvest should get wet. It seems that the ditches cut across the embankment

raised around the plots, to be watered from tanks, well and rivers in case of drought, let out surplus water during excessive rainfall and in times of rain after prolonged drought the gaps in the embankment were sealed to hold the water for the sun-burnt plots exactly as peasants do today. When crops were ripe, the threshing floor was made ready and *methi* or *meha* (in Maithili language the post of the threshing floor) was planted with care on an auspicious day.<sup>211</sup> The harvest was then threshed, winnowed and garnered after setting aside the rice of the king for tax that were measured with grain basket.<sup>212</sup>

In this age the tools and methods of agriculture underwent a radical change. The use of iron hoe, shares and sickles boosted production. Between c.700-200 BC Rice, barley, wheat, green gram or *mung*, gram chickpea, pea, *kodo* and *khesari* can be found in Khairdih.<sup>213</sup> Several important addition are made in the list during the age of Buddha. Mustard is mentioned in the early Pali texts. Both mustard and sesame oil may have been used in cooking. Further a great variety of pulses began to be cultivated. Sugarcane is mentioned in the Pali and Sanskrit texts. In the succeeding period principal crops were various kinds of rice, barley, millet, wheat and leguminous plants (mugga). Besides the above crops, certain texts mention sugarcane, fruits and vegetables.<sup>214</sup> The Jatakas suggest a similar pattern and tell us that barely continued to be the principal crop besides rice. The Jatakas mark the utilization of new plants and fruit trees. Mangogroves are frequently mentioned and so are the *sala* groves. The knowledge of the use of *jambu*, madhuka and palasa must have proved economically useful. There were different spices like khuddakaraja, maharaja, etc. under each head. The different kinds of oilseeds cultivated for oilextraction were sesame (*tila*) and mustard in order of generality. At many places the food crops as well as edible fruits grew spontaneously without tillage. The Jatakas frequently go to length about the crops and fruits growing in wild areas without human labour. Cultivation of vegetables was a pursuit apart from growing cereals. In a forest scene convolvulus, cucumber, pumpkin, ground gourd and other creepers are found in luxuriant tangles. These green crops were gathered by villagers from the forest and disposed of at the market place.<sup>215</sup> Sometimes these were grown with care. The Bodhisattva once earned his living as kitchen-gardener by growing potherbs, pumpkins, gourd and cucumber.<sup>216</sup> A false ascetic similarly cultivated vegetable pot-herbs and runners in a king's park and vended them to dealers. Between the town and the countryside the green grocer had a volume of business.<sup>217</sup> All these constitute impressive progress in agriculture.

Thus a set of variable factors led to the production of agrarian surplus. Bodhisattva's association with selling corn, landowner's family as well as reference to land-owner going to villages to collect debts, advancement in agricultural technology and state structure of the Maurya indicate the availability of a sizeable amount of surplus.<sup>218</sup> These are the projections that separate the peasant from those who siphon off his surplus fund<sup>219</sup> which in turn, provided the social context of the technological and economic progress during early India.

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### HINDUISM AND DECLINE IN BRAHMAN POPULATION IN INDIA: A REVIEW

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#### ABSTRACT

Hinduism can, indeed, apply be described as a religion of noreligion. It is a religion in so far as it emphasizes the necessity of living in harmony with the basic spiritual truths of existence; and yet it is not a religion in so far as it does not set itself in opposition to the other great religions of the world but insists upon the human spirit's going beyond all doctrinal religions. Hinduism has been constant in its affirmation of the essential unity of all religions as different lines of approach to the same fundamental spiritual reality of the world. The concept of Brahman may be said to constitute the central core of the philosophical outlook of Hinduism. It is the master idea in the Vedas and the Upanishads, which have been the fountain-source of inspiration in Indian culture down through the ages. It has imparted to Hinduism its remarkable catholicity of outlook, its power to absorb in a spirit of creative synthesis the different streams of cultural influence that have poured into India in the course of the centuries, its boundless vitality in withstanding the successive waves of alien attack in the cultural field, and its limitless tolerance in allowing within itself the peaceful growth of all types of doctrinal systems and spiritual practices. It is the concept of Brahman, which makes Hinduism a kind of universal and eternal religion. This paper deliberates upon the fundamentals of Hinduism and the concept of Brahman as a philosophical and theological semantic category as well as a caste.

Keywords: Brahman, caste system, guna, Harijana, karma, Varna, Vedas.

### INTRODUCTION

The word "religion" comes from the Latin word "*religio*," which consists of two words, viz., *re* (back) and *ligare* (to bring or bind). That which binds the soul back to God is religion. Religion shows the way for the attainment of God-realization. Religion satisfies the deep

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inward craving in a man who is not always content with leading merely an animal existence and wants spiritual consolation, solace, and peace. Man cannot live by bread alone. A time comes in the life of many of us when mere worldly prosperity does not satisfy us, and we hanker after something more. In the case of many more trials and tribulations of life, turn their attention to spiritual solace.

Hinduism is an ongoing movement and civilization of South Asia and is the dominant religion in India, and its historical tradition and philosophy are founded on four Vedas, which are the mythical (ancient) history of different ages of Hinduism. Any prophet does not found this. Buddhism, Christianity, and Mohammedanism owe their origin to the prophets. Their dates are fixed. But no such date can be fixed for Hinduism. Hinduism is not born of the teachings of particular prophets. It is not based on a set of dogmas preached by a particular set of teachers. It is free from religious fanaticism. In other words, the thought and consequently, the behavior of Hinduism both are essentially linked and connected lifestyle with the historical heritage and pragmatic aptitude. Along with an extreme attachment with the historical heritage is also attached to the earthly center of geographical enclosure or country worship (patriotism), which is now called Bharat Mata (Mother India). The foundations on which Hinduism is established are the caste system and idol worship. These, infact, constitute Hindu society, Hindu rule, and practically Arva Samaj. Social interactions are characterized by cultural homophile[1]. A growing literature shows that cultural proximity among members of a group impacts economic outcomes, although the direction of this impact is not always the same. However, previous studies have examined such proximity among coarse groups, such as gender, race, and ethnicity[2]. In this paper, we examine whether and to what extent two cultural factors, religion and caste, a traditional institution that divides Hindu society between India into thousands of hierarchical groups, influence large public and private firms in India.

Most of the scholars believe Hinduism[3], formally Hinduism started somewhere between 2300 B.C. - 1500 B.C. in the Indus Valley[4], still this place is nearby modernday Pakistan. But a lot of Hindus argue that their faith is timeless and has always existed. Hindus began to emphasize the worship of deities, especially Vishnu, Shiva, and Devi. Unlike other religions, Hinduism has no single founder but is instead a fusion of various beliefs. The timeline for the development of Hinduism is shown in Figure 1. Around 1500 B.C., the Indo-Aryan people migrated to the Indus Valley, and their language and culture blended with that of the indigenous people living in the region. There is some debate over who influenced whom during this period. Hinduism is generally regarded as the world's oldest organized religion. It consists of "thousands of different religious groups that have evolved in India since 1500 BC." Because of the wide variety of Hindu traditions, freedom of belief and practice have traditionally been notable features of Hinduism. The period when the Vedas were composed became known as the "Vedic Period" and lasted from about 1500 B.C. to 500 B.C. Rituals, such as sacrifices and chanting, were common in the Vedic Period. The epics, Puranic, and Classic Periods, were composed between 500 B.C., and 500 A.D. Hindus began to emphasize the worship of deities, especially Vishnu, Shiva, and Devi.



### Figure 1: Timeline of Hinduism

Hinduism has grown to become the world's third-largest religion, after Christianity and Islam. It claims about 950 million followers, about 14% of the world's population (see Figure 2 for the population trend of India). It is the dominant religion in India, where 95% of the world's Hindus live. Figure 3 presents the distribution of the religion-wisepopulation in India.



### Population of India (in millions)

\*Represents expected value

### Figure2: Population of India (1951-2018)

It is also very common in Nepal, and among the Tamils in Sri Lanka. Most forms of Hinduism are henotheistic religions. They recognize a single deity and view other Gods and Goddesses as manifestations or aspects of that supreme God or Goddess. Henotheistic and polytheistic religions have traditionally been among the world's most religiously tolerant faiths.



Figure3: Distribution of religions in India (a) all (b) and Hindus.

Hinduism is the world's oldest religion, according to many scholars, with roots and customs dating back to more than 4,000 years. Today, with about 900 million followers[2], Hinduism is the third-largest religion behind Christianity[5] and Islam[6]. Roughly 95 percent of the world's Hindus live in India[7]. Because religion has no specific founder, it's difficult to trace its origins and history. Hinduism is unique in that it's not a single religion but a compilation of many traditions and philosophies.

### Hinduism in Foreign Lands

Hinduism, until the modern era, mostly spread through traders and merchants who traveled to places outside Indic cultural sphere, i.e., Bhārata Varṣa (present-day India, Pakistan, Nepal, Afghanistan, Bangladesh, Sri Lanka, Bhutan and parts of modern China). However, there were some seafaring Indian Empires also which established their territories outside the Indian subcontinent and brought Hinduism to those areas, as shown in Figure 4.



Figure 4:Spread of Hinduism in SE Asia

There was a time when entire South Asia, South-east Asia, Western Tibet, Yazihidis, parts of Persia & Uzbekistan, etc. followed Hinduism.

By 2011 Hinduism was the majority religion in India (79.8%), Nepal (81.3%), Mauritius (48.5%), Bali (83.5%); the largest minority in Guyana (24.83%), Fiji (33%), Surinam (27.4%), Bhutan (25%); and the third largest religion in the world. In several other countries, including Malaysia, Bangladesh, Sri Lanka, Pakistan, Fiji, the USA, and the UK, Hindus constitute a minority. Of the world's 200 countries, Hindus are found in measurable numbers in 114 countries after Christians and Muslims.

### **Hindu Deities**

Hindu theology is mainly the study and doctrine of the worship and adoration of six forms of the Godhead as Ganesha, Devi (Durga, Lakshmi, Sarasvati), Siva, Vishnu, Surya, and Skanda. These aspects of divine worship are known as Shanmata(षण्मत) or the Six fold religious practice of the Hindus. Hinduism is extremely catholic, liberal, tolerant and elastic. This is the wonderful feature of Hinduism. A foreigner is struck with astonishment when he hears about the diverse sects and creeds of Hinduism. But these varieties are really an ornament to Hinduism. These are not certainly its defects. There are various types of minds and temperaments. This necessitates the multiplicity of faiths. This is but natural. This is the cardinal tenet of Hinduism. There is room in Hinduism for all types of souls—from the highest to the lowest—for their growth and evolution.

Hindus worship many gods and goddesses in addition to Brahman, who is believed to be the supreme God force present in all things.

Some of the most prominent deities include:

- Brahma: the god responsible for the creation of the world and all living things;
- Vishnu: the god that preserves and protects the universe;
- Shiva: the god that destroys the universe to recreate it;
- Devi: the goddess that fights to restore dharma;
- Krishna: the god of compassion, tenderness, and love;
- Lakshmi: the goddess of wealth and purity;
- Saraswati: the goddess of learning.

### Hindu Worship

Worship is the expression of devotion, reverence, and love to the Lord, of keen yearning to be united with Him and of spiritual thirsting to hold conscious communion with Him. The devotee prays to the Lord for granting him intense devotion and removing the veil of ignorance. He pines for His benign grace. He constantly remembers His Name. He repeats His Mantra. He sings His praise. He does Kirtana. He hears and recites His *Lilas*. He lives in His Dhama in the company of His devotees. He meditates on His form, His nature, His attributes, and His *Lilas*. He visualizes the form of the Lord with closed eyes and enjoys supreme peace and bliss.

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Hindu worship, which is known as "puja," typically takes place in the Mandir (referred to as a"temple"). Followers of Hinduism can visit the Mandir any time they please .Hindus can also worship at home, and many have a special shrine dedicated to certain gods and goddesses. The giving of offerings is an important part of Hindu worship. It's a common practice to present gifts, such as flowers or oils, to a god or goddess. Additionally, many Hindus take pilgrimages to temples and other sacred sites in India.

Puja is the common term forritual worship, of which there are numerous synonyms such as Archana, Vandana, Bhajana, etc., though some of these stress certain aspects of it. The object of worship is the IshtaDevata or guiding Deity or the particular form of the Deity whom the devotee worships—Narayana or Vishnu as such, or His forms as Rama and Krishna in the case of Vaishnavas, Siva in His eight forms in the case of Saivas and Devi in the case of Saktas. The devotee sometimes selects his Kuladeva or Kuladevi, family Deva or Devi, for his worship. Sometimes, the Devata is chosen for him by his Guru or spiritual preceptor. Sometimes, he himselfchooses that Devata, which most appeals to him. This form is his Ishta Devata. Worship of the Lord purifies the heart, generates harmonious vibrations, steadies the mind, purifies and ennobles the emotions, harmonizes the five sheaths, and eventually leads to communion, fellowship, or God-realization.

### **Beliefs in Hinduism**

Some basic concepts of Hinduism are as follow:

- Hinduism embraces many religious ideas. For this reason, it's sometimes referred to as a "way of life" or a "family of religions," as opposed to a single, organized religion.
- Most forms of Hinduism are henotheistic, which means they worship a single deity, known as "Brahman," but still recognize other gods and goddesses. Followers believe there are multiple paths to attaining their god.
- Hindus believe in the doctrines of *samsara* (the continuous cycle of life, death, and reincarnation) and karma (the universal law of cause and effect).
- One of the key thoughts of Hinduism is "*atman*," or the belief in the soul. This philosophy holds that living creatures have a soul, and they're all part of the supreme soul. The goal is to achieve "*moksha*," or salvation, which ends the cycle of rebirths to become part of the absolute soul.
- One fundamental principle of religion is the idea that people's actions and thoughts directly determine their current life and future lives.
- Hindus strive to achieve dharma, which is a code of living that emphasizes good conduct and morality.
- *Om* and *Swastika* are symbols of Hinduism. The Swastika, which represents good luck, later became associated with evil when Germany's Nazi Party made it their symbol in 1920.
- Hindus revere all living creatures and consider the cow a sacred animal.
- Food is an important part of life for Hindus. Most don't eat beef or pork, and many

are vegetarians.

• Hinduism is closely related to other Indian religions, including Buddhism[8], Sikhism[9], and Jainism[10].

### **Hindu** Texts

Hindus value many sacred writings as opposed to one holy book. The primary texts, known as the Vedas[11], were composed around 1500 B.C. This collection of sacred verses and hymns was written in Sanskrit and contained revelations received by ancient saints and sages.

The Vedas are four in number:

- The Rig Veda
- The Sama Veda
- Yajur Veda
- Atharva Veda

The Yajur-Veda is again divided into two parts, the Sukla and the Krishna. The Krishna or the Taittriya is the older book, and the Sukla, or the Vajasaneya, is a later revelation to sage Yajnavalkya from the resplendent Sun-God. The Rig-Veda is divided into twenty-one sections, the Yajur-Veda into one hundred and nine sections, the Sama-Veda into one thousand sections, and the Atharva-Veda into fifty sections. In all, the whole Veda is thus divided into one thousand one hundred and eighty rescissions. Each Veda consists of four parts: the Mantra-Samhitas or hymns, the Brahmanas or explanations of mantras and rituals, the *Aranyakas*, and the Upanishads. The division of the Vedas into four parts is to suit the four stages in a man's life.

The Mantra-Samhitas are hymns in praise of the Vedic God for attaining material prosperity here and happiness hereafter. They are metrical poems comprising prayers, hymns, and incantations addressed to various deities, both subjective and objective. The Mantra portion of the Vedas is useful for the Brahmacharins.

The Aranyakas are the forest books, the mystical sylvan texts which give philosophical interpretations of the rituals. The Aranyakas are intended for the Vanaprasthas or hermits, who prepare themselves for taking Sannyasa[12].

The Upanishads are the most important portion of the Vedas. The Upanishads contain the essence of the knowledge portion of the Vedas. The philosophy of the Upanishads is sublime, profound, lofty, and soul-stirring. The Upanishads speak of the identity of the individual soul and the Supreme Soul[13]. They reveal the most subtle and deep spiritual truths. The Upanishads are useful for the Sannyasins.

The subject matter of the whole Veda is divided into Karma-Kanda, Upasana-Kanda, and Jnana-Kanda. The Karma-Kanda or Ritualistic Section deals with various sacrifices and rituals. The Upasana-Kanda or Worship-Section deals with various kinds of worship or meditation. The Jnana-Kanda or Knowledge-Section deals with the highest knowledge of Nirguna Brahman. The Mantras and the Brahmanas constitute Karma-Kanda; the Aranyakas, Upasana-Kanda;

and the Upanishads, Jnana-Kanda. Hindus believe that the Vedas transcend all time and don't have a beginning or an end. The Upanishads[14], the Bhagavad Gita[15, 16], 18 Puranas[17], Ramayana, and Mahabharata [18] are also considered important texts in Hinduism.

### Hindu Festivals

Hindus observe numerous sacred days, holidays, and festivals. Some of the most well-known include:

- Diwali: the festival of lights;
- Navaratri: a celebration of fertility and harvest;
- Holi: a spring festival;
- Janmashtami: a tribute to Krishna's birthday;
- RakshaBandhan: a celebration of the bond between brother and sister;
- Mahashivaratri: the great festival of Shiva.

### **Hindu Practice**

The second strand in the fabric of Hinduism is practice. Many Hindus would place this first. Despite India's enormous diversity, a common grammar of ritual behavior connects various places, strata, and periods of Hindu life[19]. While it is true that various elements of Vedic ritual survive in modern practice and thereby serve a unifying function, much more influential commonalities appear in the worship of icons or images (Pratima, murti, or archa). Broadly, this is called puja ("honoring"); if performed in a temple by a priest, it is called archana[20]. It echoes conventions of hospitality that might be performed for an honored guest, especially the giving and sharing of food. Such food is called Prasada (Hindi, prasad, meaning "grace"), reflecting the recognition that when human beings make offerings to deities, the initiative is not theirs. They are responding to the generosity that bore them into a world fecund with life and possibility. The divine personality installed as a home or temple image receives Prasada, tasting it (Hindus differ as to whether this is a real or symbolic act, gross or subtle) and offering the remains to worshipers. Some Hindus also believe that *Prasada* is infused with the grace of the deity to whom it is offered. Consuming these leftovers, worshipers accept their status as beings inferior to and dependent upon the divine. An element of tension arises because the logic of puja and Prasada seems to accord all humans an equal status concerning God, yet exclusionary rules have sometimes been sanctified rather than challenged by Prasada-based ritual.

### **Caste System**

In *Purusha-Sukta* of the Rig-Veda, there is a reference to the division of Hindu society into four classes. It is described there that the Brahmanas came out of the face of the Lord, the Creator, and Kshatriyas from His arms, and Vaisyas from His thighs, and the Shudras from his feet.

This division is according to the Guna and Karma. Guna (quality) and Karma (kind of work) determine the caste of a man. This is supported by Lord Krishna in the *Gita*, also[21]. He says in the *Gita*: "The four castes were emanated by me, by the different distribution of qualities and actions. Know Me to be the author of them, though the actionless and inexhaustible."
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The origins of the caste system in India and Nepal are shrouded, but it seems to have originated more than two thousand years ago[22]. Under this system, which is associated with Hinduism, people were categorized by their occupations. Although originally caste depended upon a person's work, it soon became hereditary. Each person was born into an unalterable social status.

Indian society has traditionally been divided into a hierarchical system based on their *karma* and *dharma* called caste or *jati*, as shown in Figure 5, which is not limited to Hindus, but which most Hindus have observed throughout history. It is hereditary, and each caste has its own set of values, rules, dietary beliefs, etc. as presented in Figure 6,the origin of the caste system. Many do not marry outside their castes.Many scholars believe the system dates back more than 3,000 years[23-25].

The four main castes (in order of prominence) include:

- 1. Brahmin: the intellectual and spiritual leaders
- 2. Kshatriyas: the protectors and public servants of society
- 3. Vaisyas: the skillful producers
- 4. Shudras: the unskilled laborers

In a broad sense, a Sattvic man, who is pious and virtuous and leads the divine life, is a Brahmana, a Rajasic man with heroic quality is a Kshatriya, a Rajasic man with business tendencies is a Vaisya, and a Tamasic man is a Sudra[26]. Hitler and Mussolini were Kshatriyas. Ford was a Vaisya. Serenity, self-restraint, austerity, purity, forgiveness, and also, uprightness, knowledge, realization, and belief in God are the duties of the Brahmanas, born of (their own) nature. Prowess, splendor, firmness, dexterity, and also, not flying from battle, generosity, and lordliness are the duties of the Kshatriyas, born of (their own) nature. Agriculture, cattlerearing, and trade are the duties of the Vaisyas, born of (their own) nature. And action consisting of service is the duty of the Sudras, born of (their own) nature.



Figure 5: Caste system in Hinduism

Many subcategories also exist within each caste. The "untouchables" are a class of citizens that are outside the caste system and considered to be in the lowest level of the societal hierarchy [27, 28]. For centuries, the caste system determined every aspect of a person's social, professional, and religious status in India. When India became an independent nation, its constitution banned discrimination based on caste. Today, the caste system still exists in India but is loosely followed. Many of the old customs are overlooked, but some traditions, such as only marrying within a specific caste, are still embraced. There is no single founder or founding incident of Hinduism. It grew out of cultural and religious changes in India. The Hindu belief is that gods or divinities can take many forms, but all form one universal spirit called Brahman. The three most important representations of Brahman are Brahma, the creator of the universe, Vishnu, the preserver of the universe, and Shiva, the destroyer of the universe.

There are some that do not fall into any of these categories, and they are now considered part of the Scheduled Caste. They are lower than the Shudras on the hierarchy, and they are people who perform "unclean" work, such as leather working and street cleaning. They have been called untouchables, Dalits, Harijans,or backward castes. Although Hinduism teaches that discrimination and prejudice go against the idea of the divinity of all beings, both sometimes exist within the caste system. Mahatma Gandhi called these untouchables "children of God." Although the 1950 Indian constitution outlawed "untouchability,"violence against themcontinues[29].



Figure 6: Origin of Caste

The Hindu belief involves reincarnation of the soul, which is rebirth after death. Hindus believe the conditions of one's present life are due to karma or accumulated good or bad behavior in past lives. One improves one's condition through good behavior and creates suffering for oneself through bad behavior. Eventually, the soul will achieve moksha, or salvation, and stop the cycle of rebirths from becoming a part of the absolute soul.

- Paths to salvation are called the *marga* or *yoga*.
- Karma marga performing social obligations and offering selfless service.
- *Jnana marga* studying and cultivating an intellectual understanding into one's identity with Brahman.
- Bhakti marga devotion to one's personal god.
- *Raja* or *Dhyana marga* not as widely recognized as the three outlined in the *Bhagavad Gita*, this path uses meditation to gain insight into the absolute soul that resides within one's self.

There are multiple sects, theologies, and beliefs in Hinduism, and there is no single book of doctrine, but many. It is an inclusive religious group, allowing for a lot of diversity[30]. The Vedas are the primary literary works containing sacred verses and hymns composed in Sanskrit and took on their current form around 1500 BC. The *Rig Veda* was the first of the four Vedas. The *Sama Veda, Yajur Veda*, and *Atharva Veda* followed later.

## The theology behind the Castes

## Reincarnation

A soul being reborn into a new material form after each life—is one of the central beliefs in Hinduism. Souls could move not only among different levels of human society but also into other animals, hence the vegetarianism of many Hindus.

Within a life cycle, people had little social mobility. They had to strive for virtue during their present lives to attain a higher station the next time around. A particular soul's new form depends upon the virtuousness of its previous behavior. Thus, a truly virtuous person from the Shudra caste could be rewarded with rebirth as a Brahmin in his or her next life.

## **Daily Significance of Caste**

Practices associated with caste varied through time and across India, but all shared some common features. The three key areas of life dominated by caste were marriage, meals, and religious worship.

- Marriage across caste lines was strictly forbidden; most people even married within their own sub-caste or *jati*.
- At mealtimes, anyone could accept food from the hands of a Brahmin, but a Brahmin would be polluted if he or she took certain types of food from a lower caste person. At the other extreme, if an untouchable dared to draw water from a public well, he or she polluted the water, and nobody else could use it.
- In terms of religion, as the priestly class, Brahmins presided religious rituals and services,

including preparation for festivals and holidays, as well as marriages and funerals.

- The Kshatriya and Vaisya castes had full rights to worship, but in some places, Shudras (the servant caste) were not allowed to offer sacrifices to the gods. Untouchables were barred entirely from temples, and sometimes were not even allowed to set foot on temple grounds.
- If the shadow of an untouchable touched a Brahmin, s/he would be polluted, so untouchables had to lay face-down at a distance when a Brahmin passed.

### The Untouchables

People who violated social norms could be punished by being made "untouchables"[31]. This was not the lowest caste - they and their descendants were condemned, completely outside of the caste system.Untouchableswere considered so impure that any contact with them by acastes member would contaminate the member. The caste-person would have to bathe and wash his or her clothing immediately. The Untouchables did engage in work that no-one else would do, like scavenging animal carcasses, leather-work, or killing rats and other pests. Moreover, Untouchables could not even eat in the same room as caste members and could not be cremated when they died.

#### **Origins of the Caste System**

Early written evidence about the caste system appears in the Vedas. The Rig Veda rarely mentions caste distinctions and indicates that social mobility was common. The *Bhagavad Gita*, however, from c. 200 BCE-200 CE emphasizes the importance of caste[32]. Also, the Laws of Manu or *Manusmriti* from the same era defines the rights and duties of the four different castes or varnas. Thus, it seems that the Hindu caste system began to solidify sometime between 1000 and 200 BCE.

## The Caste System during Classical Indian History

The caste system was not absolute during much of Indian history. For example, the renowned Gupta Dynasty, which ruled from 320 to 550 CE, was from the Vaishya caste rather than the Kshatriya. Many later rulers also were from different castes, such as the Madurai Nayaks (r. 1559-1739), who were Balijas (traders).

From the 12th century onward, much of India was ruled by Muslims. These rulers reduced the power of the Hindu priestly caste, the Brahmins. The traditional Hindu rulers and warriors, or Kshatriyas, nearly ceased to exist in the north and central India[33]. The Vaishya and Shudra castes also virtually vanished from power centers. Although the Muslim rulers' faith had a strong impact on the Hindu upper castes in the centers of power, anti-Muslim feeling in rural areas strengthened the caste system. Hindu villagers reconfirmed their identity through caste affiliation.

Nonetheless, during the six centuries of Islamic domination (c. 1150-1750 AD), the caste system evolved considerably. For example, Brahmins began to rely on farming for their income, since the Muslim kings did not give rich gifts to Hindu temples. This practice was considered justified so long as Shudras did the actual physical labor.

## The British Raj and Caste

When the British Raj began to take power in India in 1757 AD, they exploited the caste system as a means of social control. The British allied themselves with the Brahmin caste, restoring some of its privileges, which had been repealed by the Muslim rulers.

However, many Indian customs concerning the lower castes seemed discriminatory to the British, so were outlawed. During the 1930s and 1940s, the British government made laws to protect the 'Scheduled castes' -- untouchables and low-caste people. A movement toward the abolition of untouchability took place within Indian society in the 19th and early 20th Centuries, as well. In 1928 AD, the first temple welcomed untouchables or Dalits 'the crushed ones' to worship with its upper-caste members. Mahatma Gandhi advocated emancipation for the Dalits, too, coining the term *Harijan* or 'Children of God' to describe them.

#### **Caste Relations in Independent India**

India became independent on August 15, 1947. India's new government instituted laws to protect the Scheduled castes and tribes, which included both the untouchables and groups living traditional lifestyles. These laws include quota systems that help ensure access to education and to government posts. Thus, over the past sixty years, a person's caste has, in some ways, become more of a political category than a social or religious one.

#### Brahman

According to the theory of Brahman, the reality is, in its deepest essence, beyond all such polarities as one and many, infinite and finite, absolute and relative, and the like. But, viewed from the human standpoint, reality may be described as the identity or creative unity of all polar opposites[34]. This is *Saguna Brahman*. He may be described as the One endowed with the power of manifesting Himself as an endless many; He is the Infinite having the inherent power of manifesting Himself under the aspect of finitude? *Saguna Brahman* is at once the archetypal male and the archetypal female. That is why the Vedinta calls it Isvara-maya; the Tantras call it Siva-Sakti; Vaisnavism calls it Radha-Krishna, or Sita-Rama, or Vishnu-Lakshmi. As the archetypal male, Brahman is immutable and eternally perfect, sufficient unto itself, and is supreme knowledge or absolute thought. As the archetypal female, Brahman is endless creativity, the perpetual becoming of time, the dynamic flux of empirical existence, the principle of objectivity and love--that is the creative principle which brings into existence the objective world as an object of enjoyment for the pure subject. These two, the masculine and the feminine factors-Krishna and Radha, or Siva and Sakti-are, however, two inseparable aspects of the same cosmic principle.

The word Brahmin translates to "Supreme Self" or the first of the gods. Brahmin is the highest Varna in Vedic Hinduism. Brahman is a class (Varna) in Hinduism, specialization as teachers (Acharya), priests, and protectors of sacred learning across generations[35].

The Brahmin's traditional occupation was that of priesthood at the Hindu temples or at socio-religious ceremonies and rite of passage rituals such as solemnizing a wedding with hymns and prayers.

The population of India that is considered a member of the Brahmin caste, according to

the article "The Joshua project," is about 60,481,000 people. That's approximately 4.3 percent of the total Indian population. The Brahmin Varna consists of priests, and individuals of this specific Varna are separated into sub-castes called gotras. Because of religious and cultural diversity, Brahminsare divided into thissub-castes. Only some members are priests, other members have held professions as educators, lawmakers, scholars, doctors, writers, poets, landowners, and politicians. According to Nancy Auerbach in her book *Living Hinduism*, the Brahmin is associated with Sanatana Dharma, which was in early Hinduism, a code of ethics, or a way of living to achieve "moksha" a sense of liberation and enlightenment. As the developments of the caste system continue, Brahmins became an influential Varna in India and indulged in discrimination against the other lower castes.

Most Brahmins are located in the states of Uttarakhand, Himachal Pradesh ,and Uttar Pradesh and Andhra Pradesh and small concentrations in the southern states, which include Tamil Nadu, Karnataka, and Kerala[36] as shown in Table 1. This territorial division led to the creation of two groups among the Brahmin: the PanchGour (northerners) and the PanchDravida (Southerners)[37]. These two groups are separated by the central Indian Vindhya mountain range that almost bisects the country into two parts.

State	%	State	%
Andhra Pradesh	1%	Kerala	1%
Arunachal Pradesh	6%	Madhya Pradesh	5%
Assam	4%	Maharashtra	4%
Bihar	5%	Orissa	9%
Chhattisgarh	2%	Punjab	5%
Delhi	12%	Rajasthan	7%
Goa	7%	Sikkim	5%
Gujarat	5%	Tamil Nadu	1%
Haryana	6%	Tripura	3%
Himachal Pradesh	14%	Uttar Pradesh	10%
Jammu and Kashmir	11%	Uttarakhand	20%
Jharkhand	3%	West Bengal	5%
Karnataka	5%		

Table 1: Percentage Population of Brahman in the States of India

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Brahmin came from the term *Brahman*. The name Brahmin was given to the first trained priest who held a sacrifice. After the end of the *Rig Vedic* period in 1000 BC, the term "Brahmin" became universally known as the term for all members of the priestly class. Around 900 BC, the Brahmins were divided into exogamous clans that restricted matrimonial choice and dictated ritual. This system is still intact today, where it is frowned upon to marry someone of another caste. The *Rig Veda* is one of the most sacred Hindu scripture, and it contains the mythological origin of the Brahmin. The god Prajapati (Lord of beings) is identified with Brahma, who is the creator in the Hindu trinity and was later sacrificed by his children. This sacrifice is said to have produced the universe and that the Brahmin originated from his mouth.

Traditionally the Brahmin is supposed to become priests, but in actuality, they hold a wide variety of occupations. Many members practice agriculture, while others hold white-collar jobs[38]. The Brahmin is allowed to follow any profession, but no one except a Brahmin can become a priest. Members of this Varna tend to be strict vegetarians. It is a socio-spiritual obligation to feed Brahmin at ceremonies. Brahmin men have more freedom then Brahmin women. Men try to avoid alcohol and smoking, whereas , for women, it is strictly forbidden. The socially acceptable age for marriage also varies between the sexes. Women can get married starting from as young as 18, whereas men get married at an older age. Marriages tend to be arranged by parents, and monogamy is expected. Widows are not allowed to remarry, whereas widowers are allowedto. Although Brahmin women are second to men, they do hold a higher level of education than other women in Indian society.

Overall, Brahmins hold a high status in Hindu society and are considered to be smart and influential[39]. They set the standard of social conduct and morality due to their leadership in society. Figure 7 presents the trend in the decrease in the population of Brahman in India. Hindu priesthood is dominated by Brahmins, but other castes due in fact have "sacred specialists," but their status does not compare to that of a Brahmin.

#### Basic principles followed by Brahman

All Brahman follow the below mentioned basic principles:

- Be always truthful
- Teach his art only to virtuous men
- Follow rules of ritual purification
- Study Vedas with delight
- Never hurt any living creature
- Be gentle but steadfast
- Have self-control
- Be kind, liberal towards everyone

Then there is another connotation of Brahman. Brahmana is a portion of the Veds. There are two *Brahmanas* to the Rig-Veda; the Aitareya and the *Sankhayana*. The sacred hymns of the *Brahmanas* stand unparalleled in the literature of the whole world, and their preservation might well be called miraculous." (*History of Ancient Sanskrit Literature*)[41].



\* Represents expected value

## Figure 7:Percentage trend of Brahman caste during 1951-2018 in the Total Population of India

The *Shatapatha Brahmana* belongs to the Shukla-Yajur-Veda. The Krishna-Yajur-Veda has the *Taittiriya* and the *Maitrayana Brahmanas*[42]. The Tandya or Panchavimsa, the Shadvimsa, the Chhandogya, the Adbhuta, the Arsheya, and the Upanishad Brahmanas belong to the Sama-Veda. The Brahmana of the Atharva-Veda is called the *Gopatha*. Each of the Brahmanas has got an *Aranyaka*.

## CONCLUSION

The caste system was developed with positive ambition to build a flawless society. But the defect crept in. The classes gradually neglected their duties. The test of ability and character slowly vanished. Birth became the chief consideration in determining castes. All castes fell from their ideals and forgot all about their duties. *Brahmins* became selfish and claimed superiority over others by mere birth without possessing due qualifications, which resulted in the fast decline in terms of population. The Kshatriyas lost their chivalry and spirit of sacrifice. The Vaisyas became very greedy. They did not earn wealth through honest means. They did not look after the economic welfare of the people. They did not give charity. They also lost the spirit of sacrifice. Sudras gave up service. The greed and pride of man have created discord and disharmony. Brahmin remains the powerful caste that holds authority in the whole of the Hindu society in spite of being in the minority.

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## ASSESSMENT OF DELAYED IMMUNE RESPONSE OF LIQUID EMBOLIC SYSTEM

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#### ABSTRACT

A biomaterial is defined as any substance, except food and medications, which can be used for a length of time as part of a system that aims to treat or to replace any tissue, organ, or body function. Few materials, if any, are totally inert from a physiological standpoint; most materials present a variety of components with potential toxic or irritating properties. In addition, chemical reactions that occur during setting of the material may also produce noxious effects. To assess the delayed immune response of Liquid embolic system the study has been conducted in Dunkin Hartley Guinea pig following guideline (ISO) 10993-1, Biological evaluation of medical devices-Part 1: Evaluation and testing within a risk management process (2009)[1], ISO 10993-Part 10 (2010) [2]. Test for irritation and skin sensitization and ISO 10993-Part 12 (2012) [3] for Sample preparation and Reference materials for non-clinical Laboratory Studies have been conducted. The results of the study indicated that the Liquid Embolic system comprise of polymer dissolved in solvent and suspended radio-opaque agent is non sensitizer as it didn't cause any delayed immune response in the form of erythema or edema after induction phase.

Keywords: Biomaterial, Embolic System, Magnusson & Kligman Scale, Skin reaction, toxicity.

#### INTRODUCTION

Embolotherapy is a procedure for introducing a variety of agents into the circulation in order to occlude blood vessels for therapeutic intent, for instance to prevent bleeding, to arrest flow through abnormal connections such as arteriovenous malformations (AVMs) or to devitalise a structure, organ or tumorous mass by inducing ischemic necrosis[4]. Embolic agents come in many different forms including micro-particles, pellets, glues or metallic coils.

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These embolic are administered to targeted tissues through a catheter inserted and maneuvered through the vasculature into the desired location. [5]

One common application of this technique is the use of microparticles, most usually microspheres/beads to treat tumors in the liver where the intention is to physically occlude the vessels feeding the tumour in order to induce localised ischemic necrosis of the malignant mass.

The microparticles themselves may disappear over time if bioresorbable, or if nondegradable, should be sufficiently bio-inert and well-tolerated in tissue where they reside.[6,7]

Polymers are very versatile materials and are used in many applications including pharmaceutical applications. Natural polymers, modified natural polymers, and synthetic polymers are used as excipients in the manufacture of cosmetics and systems for conventional and modified delivery of drugs, by altering the composition and physical properties such as molecular weight, polydispersity, crystallinity, and thermal transitions. They can be prepared to provide a wide range of degradation rates and mechanical properties.

More recently, polymers have been developed that can modulate and deliver drugs to target areas. Biodegradable polymers, bioadhesives, biomimetic materials, and responsive hydrogels have been included in pharmaceutical formulations (Villanova & Oréfice, 2010). Naturally derived polymers offer several advantages compared with synthetic polymers, namely biocompatibility, biodegradability, and biological activity, as most of them are present in the structural tissues of living organisms. [8,9,10,11]

Delayed hypersensitivity reactions are characterized histologically by perivascular infiltration of mononuclear cells. Classic delayed hypersensitivity (DH) is induced by sensitization with mycobacteria or with other antigens administered in mycobacteria-containing adjuvants. A second form of delayed hypersensitivity, cutaneous basophil hypersensitivity (CBH), is induced by a variety of immunizing procedures which avoid the use of mycobacterial adjuvants. Both are effected by lymphocytes, but skin reactions of CBH are relatively nonindurated and infiltrated by large numbers of basophilic leukocytes in addition to mononuclear cells[12,13,14]. Delayed hypersensitivity reactions are inflammatory reactions initiated by mononuclear leukocytes. The term delayed is used to differentiate a secondary cellular response, which appears 48-72 hours after antigen exposure, from an immediate hypersensitivity response, which generally appears within 12 minutes of an antigen challenge. These reactions are mediated by T cells and monocytes/macrophages rather than by antibodies. They are also termed Type IV hypersensitivity reactions. Delayed hypersensitivity is a major mechanism of defense against various intracellular pathogens, including mycobacteria, fungi, and certain parasites, and it occurs in transplant rejection and tumor immunity [15,16,17].

As sensitizing chemicals diffuse into the skin, they react with some proteins of the body, changing the antigenic properties of the protein. Chemical can interact with proteins located in both the outer horny layer of the skin (dermis) and the underlying tissue (epidermis). Some of the epidermal protein complexes migrate to the draining lymph nodes, where they stimulate T cells responsive to the newly formed antigen to multiply. When the T cells leave the nodes to enter the bloodstream, they can travel back to the site where the chemical entered the body. If some of the sensitizing substance remains there, it can reactivate the T cells, inducing a

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recurrence of inflammation [18,19,20,21].

Assessment of tissue tolerance and tolerance to immune system response is critical for proper functioning of the liquid embolic system without causing any damage to surrounding tissues, as interaction with tissues and immune system is obvious.

#### MATERIAL AND METHOD

*Liquid Embolic System:* Sample of liquid embolic system was supplied by Meril Life Science Pvt Ltd. which is a polymer radio-opaque agent suspended in solvent.

*Source of Animals:* Young adult New Zealand White rabbits weighing about 2-3 kg were provided by Shriram Institute for Industrial Research, Delhi (SRI).

Chemicals: 0.9 % Physiological Saline.

*Extract Preparation*: A vial containing Liquid embolic was manually mixed for 20 minutes for homogenization of suspended polymers. After proper mixing 5 g of sample was transferred to 25 ml conical flask with stopper, which contained 25 ml 0.9 % physiological saline and marked as the extract of sample. Similarly another 25 ml conical flask containing 25 ml 0.9 % physiological saline (Extractant only), marked as Extractant was also prepared. Both these flasks were kept at 37 ° C for 72 hours in incubator. The extract preparation was done following the guideline ISO 10993 Part 12 (2012) [5].

#### **Experimental Design:**

Animal Husbandry: Ten for test group and five for Control group (male Dunkin Hartley Guinea pig of weights 300-500g), were provided by Animal House Facility of SRI. Animals were housed in group of 5 in stainless steel cages with perforated floors. The room temperature was maintained at  $20 \pm 3$  °C with 50-60 % relative humidity. The light conditions were controlled to give 12 hours of artificial light (8 a.m. - 8 p.m.) each day. Standard palleted feed was provided by Amrut Feed Ltd. and were given ad-libitum.

## **Procedure:**

Sensitization Test consists of two phases i.e., Induction phase and Challenge Phase

1) Induction phase

This phase consists of two stages:

(a) Intradermal injection, followed by

(b) Topical application after one week.

2) Challenge Phase

Topical application on untreated site after 14 days of induction phase (IInd step).

## **Preparation of Animals**

Animals were weighed, marked and clipped at the back of animal.

## **Administration of Extracts**

In the test, thirty animals were used. Twenty animals as "test group" and ten as "control

group". On the first day of treatment, fifteen guinea pigs per extract (10 test, 5 control) were weighed and identified for polar extract similarly, fifteen guinea pigs per extract (10 test, 5 control) were weighed and identified for non-polar extract.

## 1) Induction Phase

The test animals were injected with the test article extract and the control animals with extractant. Three rows of intra-dermal injection (two per row) were given to each animal within an appropriate clipped area.

## (a) Intra-dermal injections

## **Control animals:**

0.1 ml of 50:50 (v/v) mixtures of FCA and the chosen extractant.

0.1 ml of chosen extractant.

0.1 ml of 1:1 mixture of the 50:50(V/V) extractant/FCA mixtures and the extractant.

## Test animals:

0.1 ml of 50:50(v/v) mixture of FCA and the extract of test article in chosen extractant.

0.1 ml test article extract in chosen extractant.

0.1 ml OF a 1:1 mixture of the 50:50 (V/V) test article extract in chosen extractant/FCA.

Mixture and test article extract in the chosen extractant.

## (b) Topical application

The day prior to conducting the topical application the fur at the back of animal (same area as used in intra-dermal injection phase) was again removed. For topical application, sterile surgical gauze of appropriate dimensions (8cm2) moistened appropriately with extracts of test article in polar and non-polar extractant and applied to the clipped area of each animal to their respective groups, so as it cover the intra-dermal injection sites this contact was ensure by covering it with occlusive dressings.

Similarly, control animals were applied with the gauze appropriately moistened with the extractant (polar and non-polar extractant) and the applied sites were covering it with occlusive dressings. After 48 hours, dressing was removed and sites were observed for any skin reactions.

## 2) Challenge Phase

For challenge phase, on 14 days after 2nd step of induction, the fur was removed from the sides and the flank areas, which was not treated earlier.

For topical application in Challenge phase was conducted by using sterile surgical gauze of appropriate dimensions (8cm<sup>2</sup>) moistened with appropriate extracts of test article in polar and non-polar extractant and applied to the clipped area of each animal with their respective groups, so as it cover the untreated area, this contact was ensure by covering it with occlusive dressings.

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Similarly, on the control animals the extractants were applied. At 24 hours the patches were removed any residue remaining at the site was wiped of using moistened cotton with the distilled water.

The Reactions were observed at 24 and 48 hrs after the patch removal. Evaluation has been done as per the Table 1

Patch Test reaction	Grading Scale
No visible Change No visible Change	0
Discrete or patchy erythema	1
Moderate & Confluent erythema	2
Intense erythema &/or Swelling	3

Table 1: Magnusson & Kligman Scale



In the final analysis of data, consideration was given to the overall pattern, intensity, duration and character of reactions of the test as compared to the control conditions. Statistical manipulation of data was not applicable to this study. Grades of 1 or greater in the test group generally indicated sensitization, provided that grades of less than 1 were observed on the control animals. If grades of 1 or greater were noted on control animals, then the reactions of test animals that exceeded the most severe control reaction were considered to be due to sensitization.

#### RESULTS

## Table 2: Evaluation Of Skin Reactions Of Control Animals

Gr.	Skin Reaction	Time	Guinea Pig Numbers			rs	Mean	
			1	2	3	4	5	Score
Control	Erythema	After 24 Hrs	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0.0
	Erythema	After 24 Hrs	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0.0

Gr. Skin Reaction	Time	Guinea Pig Numbers										Mean	
	-	6	7	8	9	10	11	12	13	14	15	Scole	
Test	Erythema	After 24 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Erythema	After 24 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0	0	0	0	0	0.0

Table 3: Evaluation Of Skin Reactions Of Test AnimalsPhase Of Study: Challenge, Extractant Used: 0.9% Physiological Saline

# Table 4: Evaluation Of Skin Reactions Of Control Animals Phase Of Study: Challenge, Extractant Used: Cotton Seed Oil

Group	Skin Reaction	Time	Guinea Pig Numbers				Mean	
			16	17	18	19	20	Score
Control	Erythema	After 24 Hrs	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0.0
	Erythema	After 24 Hrs	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0.0



# Table 5: Evaluation of Skin Reactions Of Test AnimalsPhase of Study: Challenge, Extractant Used: Cotton Seed Oil

Group	Skin	Time		Guinea Pig Numbers							Mean		
	Reaction		21	2	23	24	25	26	27	28	29	30	Score
Test	Erythema	After 24 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Erythema	After 24 Hrs	0	0	0	0	0	0	0	0	0	0	0.0
	Edema	After 48 Hrs	0	0	0	0	0	0	0	0	0	0	0.0

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Animal No.	Group	Weight of animal (gram) on day 1st	Weight of animal (gram) at the end of study	Body weight Change
1		320	364	13.75
2		326	368	12.88
3	Control	319	357	11.91
4		329	372	13.07
5		330	370	12.12

## Table 6: Body Weight Change Data

#### Group: Control, Extractant: Physiological Saline

## Table 7: Body Weight Change Data

## Group: Test, Extractant: Physiological Saline

Animal No.	Group	Weight of animal (gram) on day 1st	Weight of animal (gram) at the end of study	Body weight Change
6		318	361	13.52
7		322	360	11.80
8		320	365	14.06
9	Test	324	367	13.27
10		327	370	13.14
11		330	371	12.42
12		325	369	13.54
13		331	370	11.78
14	]	325	365	12.31
15		320	362	13.12

## Table 8:Body Weight Change Data

## Group: Control, Extractant: Physiological Saline

Animal No.	Group	Weight of animal (gram) on day 1st	Weight of animal (gram) at the end of study	Body weight Change
16		315	360	14.28
17	Control	317	359	13.25
18	Control	327	370	13.15
19		320	362	13.12
20		324	363	12.04

Animal No.	Group	Weight of animal (gram) on day 1st	Weight of animal (gram) at the end of study	Body weight Change
21		322	370	14.91
22		318	358	12.58
23		326	368	12.88
24	Test	320	362	13.12
25	]	327	371	13.46
26		321	365	13.71
27		330	374	13.33
28		324	370	14.12
29		328	371	13.11
30		323	373	15.48

## Table 9: Body Weight Change Data

## Group: Test, Extractant: Physiological Saline

#### (i) Skin reactions

The test article did not induce any skin allergies and sensitization reactions; when the animals of the treatment group were compared to the animals of control group after the reactions were scored at 24 and 48 hrs after patch removal.

## (ii) Toxic sign/Symptoms

No clinical signs were observed in any of the guinea pigs. No mortality was noticed in any of the experiment animals.

## (iii) Body Weights

The body weights of treatment group guinea pigs were comparable with the control group animals.

## CONCLUSION

We have determined sensitization study (Maximization Method) of Liquid Embolic System by evaluating its ability to produce delayed immune response in the form of erythema and oedema where immune system of all the guinea pigs were sensitized during induction phase by intra-dermal injection of extract and extractent alone as well as along with adjuvant FCA in 50: 50 ratio. The animals also undergo topical induction phase were test item extract and extractents only were topically applied. After 14 days of interval the sensitized immune system of animals were challenged with treatment with extract and extractants topically and the skin were scored as per Magnusson & Kligman Scale. The embolic extract was concluded to be non-Sensitizer in nature. Thus the embolic system can be considered to be safe in terms of hypersensitivity of delayed type and can say it will not elicit any immune response to cause damage to surrounding tissues.

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## DETECTION AND CLASSIFICATION OF TUMOUR

## Muneer Ahmed\*

#### ABSTRACT

Medical pictures are significant element of a patient's health record and are related to manipulation, process and handling of information by computers. This makes the premise for the computer-assisted development of radiology Medical image classification plays a very important role in diagnostic and teaching functions in drugs. For these functions completely different imaging modalities are used. There are several classifications created for medical pictures. In this paper, recent techniques of image classification have been discussed.

**Keywords:** Colour imaging, Hyperplane, neural network, Perceptron, Statistical Learning Technique, Support Vector Machines (SVMs), tumour.

#### **INTRODUCTION**

Medical image classification will play a very important role in diagnostic and teaching functions in drugs. For these functions, completely different imaging modalities are used. There are several classifications created for medical pictures. First classification is that of grey-scale and color medical pictures. Another method is to search out the feel of the photographs and have the analysis. Texture classification is a picture process technique by which completely different regions of a picture are known supported texture properties [1]. Second manner is by classification using neural network classification techniques and therefore the final one is by classification, with the assistance of supervised and unsupervised techniques. The word data processing refers to, extracting the data from giant amounts of information. It's one amongst the realm that uses applied mathematics, machine learning, image and alternative information manipulation with data extraction techniques [2].

Medical pictures are significant element of a patient's health record and are related to manipulation, process and handling of information by computers. This makes the premise

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for the computer-assisted radiology development. More developments are related to the utilization of call support systems that helps to come to a decision, the relevant data for designation.

## **ARTIFICIAL NEURAL NETWORKS**

The human brain processes, stores and retrieves info in a completely totally different thanks to the standard electronic computer. Although, some computer systems are quicker than the brain once processing numerical knowledge, nevertheless in advanced machine tasks – like face recognition and alternative tasks involving pattern recognition – the brain outperforms any known system. This often chiefly owes to variety of options the human brain has that will be terribly helpful in artificial systems. The brain may be an extremely advanced, nonlinear and parallel system of easy biological process units. Brain has neurons, (approximately  $10^{(10)}$ ) having over  $(10)^{(13)}$  interconnections [1]). Neural events occur at milliseconds whereas events in typical computers occur in nanoseconds. The brain but, overcomes this slow speed through its huge range of neurons and interconnections. What is more, it's strong, fault tolerant and versatile and might adjust with fuzzy, probabilistic, noisy, or inconsistent info.

This recognition of the brain's power has generated interest for the development of Artificial Neural Network (ANN) technology that is harnessed by the approach the brain processes information. Originally trying to model the human brain and its learning capabilities, Artificial Neural Networks or simply Neural Networks (NNets) haven't been given a universally accepted definition, however the general public within the field would agree that a neural network consists of units (processors, nodes) that are interconnected with many alternative such units that operate severally of the input they're given and their native knowledge [2]. Some NNets attempt to model biological neural networks by parallel computing design supported brain-like IP models and intrinsically they'll exhibit brain-like behaviors like learning, association, categorization, generalization, rule extraction, improvement, etc.

#### **Biological & Artificial Neuron**

A biological somatic cell will be connected to concerning [10]<sup>A</sup> different neurons through axons, conjunction junctions (synapses) and dendrites (tree-like networks of nerve fibres). A diagram of one somatic cell is shown in Figure 1. At the cell body, the soma, a typical somatic cell collects signals from others through the dendrites and sends out spikes of electrical activity through a protracted, skinny stand called the nerve fiber. The nerve fiber splits into branches at the top of that, a conjunction converts the activity from the nerve fiber into electrical effects that inhibit or excite activity within the connected neurons. Once a somatic cell receives excitative input that's sufficiently massive compared with its restrictive input, it sends a spike of electrical activity down its nerve fibre. Learning happens once modifications square measure created to the effective coupling between somatic cells at the conjunction junction in order that the influence of a neuron on another changes.



Figure 1: Schematic Illustrations of the Basic Features of a Biological Neuron and its Basic Model by Mcculloch and Pitts

The brain cells are able to perform more complex tasks than summation of the inputs they receive, but this is a reasonable approximation. The first attempts to model the operation of a biological neuron were made by McCulloch and Pitts in 1943 [3] based on their understanding of neurobiology [3]. Their model made several assumptions and was based on simple neurons which were considered to be binary devices with fixed thresholds. The results of this model were simple logic functions such as "a or b" and "a and b". Considering a neural network with n such McCulloch-Pitts neurons (model neurons, units or nodes), each having two states (+1 if excited and -1 inhibited), the updating rule of the model can be given by

 $s_i^t = sign(\emptyset_i^t) \qquad (1.1)$ 

Assuming the threshold is zero for simplicity. In equation (1.1) is the membrane potential (sum of all inputs) of the neuron *i* at time *t*, sign(x) = +1, for x > 0 and sign(x) = -1 for x > 0. sign is called the sign-function and it describes the processing task of the neuron. This function is usually called an updating function or activation function. If (1, 0) is used instead of (+1,-1), then the step function or Heaviside function can be used in place of equation (1.1):

$$s_i^t = \theta(\emptyset_i^t) \qquad (1.2)$$
  
Where  $\theta = \begin{cases} 1 & x > \\ 0 & x < \end{cases}$ 

The membrane potential  $\emptyset_i^t$  of the McCulloch-Pitts model is the weighted sum of all the inputs to the neuron *i* at time *t*, i.e

$$\emptyset_i^t = \sum_{j=1}^n w_{ij} s_j^t \qquad (1.3)$$

Where i, j=1, 2, ..., n. The weight  $w_{ij}$  represents the strength of the synapse connecting neuron j to neuron i and can be excitatory (positive) or inhibitory (negative). By combining equation (1.1) and (1.3) the following equation can be obtained:

$$s_i^{t+1} = sign(\sum_{j=1}^n w_{ij} s_j^t)$$
(1.4)

#### **Neural Network Architectures**

Artificial Neural Networks can be divided into two main categories based on their processing structure (known as architecture or topology): feed-forward and feedback or recurrent neural networks (Fig.2).



Fig. 2 (a) Feedback (b) Feed-Forward Neural Network

Feed-forward neural networks (Fig. 2(b)) allow signals to travel one way only; from input to output. There are no feedback (loop) connections. Feed-forward networks tend to be straight forward models that associate inputs with outputs. They are extensively used in pattern recognition. This type of organization is also referred to as bottom-up or top-down.

In feedback k neural networks, signals will travel in each direction. Therefore the network has loops in its topology Networks with this structure can be very complicated and powerful, as they can continuously change state until equilibrium in reached - this balanced state is then kept up until changes in the input data occur. These architectures are also called recurrent although this usually refers to feedback connections in networks with a single layer of nodes.

These architectures can be further subdivided into two main classes based on the number of layers of processing nodes used in the model. In a single-layered network there is a layer of input nodes and a layer of output nodes, which are the only processing nodes in the model. In a multi-layered network there is one or more layers between the input and the output nodes called hidden layers. The nodes belonging to these layers are usually referred to as hidden nodes.

#### **The Perceptron**

In 1958, Frank Rosenblatt designed the first artificial neural network by interconnecting a number of McCulloch-Pitts neurons in a simple fashion [4]. He studied networks of model neurons with threshold activation functions and called them "Perceptron". The procedure that enables Perceptron models to learn and be trained on specific exemplar data was introduced

by Rosenblatt in 1962 and is known as the Perceptron Learning Algorithm [5]. This is guaranteed to converge on a suitable set of weights if a solution exists [1]. The algorithm can be summarized as follows:

1. Initialize weights and thresholds to random small values.

2. Present input example and desired output.

3. Calculate the actual output (eq. (6.3)):  $o^t = f \sum_{i=0}^n w_i^t x_i^t$ , where n is the total number of inputs,  $\uparrow w_i^t$  is the weight from input i at time t and f(x) is the activation function.

4. Update the weights to reinforce correct decisions and discourage incorrect decisions (reduce error):

```
\begin{array}{l} \textit{if correct } w_i^{t+1} = w_i^t \\ \textit{if output 0 should be 1} \quad w_i^{t+1} = w_i^t + x_i^t \\ \textit{if output 1 should be 0} \quad w_i^{t+1} = w_i^t - x_i^t \end{array}
```

5. Present the next example and repeat from step 3.

The main difficulty in the above algorithm is properly updating the weights (step 4) so that the difference between the actual and the target output is as small as possible. Based on this idea, a lot of modifications have been suggested for the basic perception algorithm in order to improve its performance. One modification to the algorithm is to introduce a multiplicative factor into the weight adaptation term. This slows down the change in the weights, forcing the network to take smaller steps towards the solution. Hence, step 4 of the basic algorithm above is replaced by:

if correct 
$$w_i^{t+1} = w_i^t$$
  
if output 0 should be 1  $w_i^{t+1} = w_i^t + \eta x_i^t$   
if output 1 should be 0  $w_i^{t+1} = w_i^t - \eta x_i^t$ 

Where, a positive gain term that controls the adaptation rate (learning rate). Another very important modification was introduced by Widrow and Hoff, known as Widrow-Hoff rule or delta rule [6]. Windrow and Hoff realised that it would be best to have variable weight adjustments, depending on how long away is the actual output from the desired value. The delta rule calculates the difference between the weighted sum and the target output and calls that the error. The error term can be written , where is the desired response of the system and is the actualresponse. Step 4 of the basic algorithm above can therefore be replaced by:

```
\begin{array}{l} \mbox{if correct } w_i^{t+1} = w_i^t \\ \mbox{otherwise calculate } \Delta = y^t - o^t \\ \mbox{and update the weights } w_i^{t+1} = w_i^t + \eta \Delta x_i^t \end{array}
```

Where ,a positive gain term that controls the adaptation rate.

#### **Limitations of the Perceptron**

In 1969, Minsky and Papert pointed in their book, "*Perceptrons*", that capabilities of single-layered networks are limited, as this architecture (no hidden nodes) can only solve linearly separable problems. A simple example that is commonly used to demonstrate this limitation is the exclusive-OR (X-OR) logic function which accepts two inputs (0 or 1) and produces an output of 1 only if either input is 1; otherwise it outputs 0 (Figure 3). If the output is plotted in a two-dimensional space, it can be shown that it is impossible to draw a single straight line between the two output classes. In [1] it is easily shown that the exclusive-or problem cannot be simulated by a single-layered network, since there is no set of weights that completely satisfies the truth table of the X-OR function.



#### Figure 3: The Exclusive-OR (X-OR) Logic Function [1]

Many classification problems are not linearly separable and this leads to the use of multilayered networks that are capable of dealing with non-linear classification problems (it can form more complex decision regions) due to the use of additional layers of processing nodes.

#### **Multi-layer Perceptron** (MLP)

Multi-layer Perceptron (MLP) is the architecture that most people prefer for its capability of performing arbitrary classifications. The following section gives a description of one of the most commonly used learning algorithms for the MLP, suggested by Rumelhart and McClelland [8].

#### The Back-Propagation algorithm (BP)

The learning algorithm used for multi-layered perceptrons is called generalized delta rule or back-propagation rule and it was developed by Rumelhart, McClelland and Williams in 1986 and their work is delineated in their book titled "*Parallel Distributed Processing*". The back-propagation rule generalizes the delta rule delineated in Section 1.1.2.1.Convergence is not guaranteed and it is frequently slow even when it converges. The algorithm is a gradient descent method and uses an error function that represents the difference between the network's calculated output and the desired output. In order to learn successfully, the network's output should approach the target output by continuously reducing the value of this error. The generalized delta rule calculates the error for a specific input and so back-propagates the error from one layer to the previous one. The association weights between the nodes area unit adjusted in line with the back-propagated error in order that the error operate is reduced and

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therefore the network learns.

Scaled Conjugate Gradient Algorithm (SCG)

The Scaled Conjugate Gradient (SCG) algorithm is a member of the class of conjugate gradient methods. These are general purpose second-order techniques that minimize goal functions. Unlike the back-propagation algorithm, which is a first-order technique, these methods make use of the second derivatives of the goal function. This allows them to find a better way to a minimum than a first-order technique, but at a higher computational cost. In a similar fashion to the back-propagation algorithm, conjugate gradient methods try to get closer to the minimum of the function, but instead of always proceeding down the gradient of the error function, they follow a direction conjugate to the directions of the previous steps. Most minimization methods use first-order derivatives combined with line search methods along selected direction, a sine back-propagation.

#### **Design Issues & Training of ANNs**

When it comes to deciding which ANN architecture to use and which algorithm to apply to this structure, there is no easy answer. Selection of a suitable combination of these two design components is often done experimentally and it is problem dependent (i.e. the difference between a classification and a time-series prediction problem will probably result in the use of a feed-forward neural network for the first and a recurrent neural network for the second problem, respectively). In general, the specification and design of an ANN should aim to produce the system with the optimum overall performance, although this, together with what should be considered 'optimum' performance, is also problem dependent. In most applications – and especially in medical problems – ANNs should be used to supplement conventional methods. Furthermore, in some cases it might be necessary for the neural network not to try and improve the overall performance only, but mainly focus on the improvement or restriction only of the performance over one or more specific classes of the data.

There are several issues to be considered when designing a neural network application, aiming to achieve a good generalization performance -i.e. to have the outputs of the network approximate well target values given inputs that are not in the training set. The design of a machine learning system in general usually involves the following tasks:

(a) Data collection: It is a necessary condition for good generalization that the training cases be a sufficiently large and representative subset (the sample) of the set of all cases that need to generalize to (the population). For unseen cases that are nearby training examples in the feature space the trained network needs to interpolate, which can often be done reliably. For unseen cases that may lie farther away from training examples (inside or outside the range of the training set) the network needs to extrapolate, which is notoriously unreliable. Hence, it is important to have sufficient training data to avoid the need for extrapolation.

Thus, if the input-output function to be learned is smooth, the correct output for a test example that lies close to some training cases will be close to the correct outputs of those training cases. Hence, with proper training and given a sufficient sample for the training set, a neural network will be able to generalize reliably to the population.

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(b) Pre-processing Data: This step is usually needed in order to extract information (in the form of features) related to the problem. That might be necessary if the original (or raw) data is in a format not suitable for use by the neural network. For example, in a medical vision problem it might be necessary to capture images from the media that is normally used by the medical personnel (e.g. microscope, X-rays, MRIs, etc.) and then digitize them, if they are not already digitized. In addition, because of hardware and software restrictions, it might also be considered necessary to pre-processes the images so that significant features of image objects related to the decision making process can be extracted and numerically expressed.

(c) Feature Extraction: The inputs to the network should contain sufficient information pertaining to the target, so that there exists a mathematical function relating correct outputs to inputs with the desired degree of accuracy. For example, when classifying image objects using a set of outdoor scene images, just the use of color might not be sufficient input for a proper categorization of the objects; additional information such as shape, size and texture might be necessary for discriminating between objects of different categories. Finding good inputs for a classifier and collecting enough training data often take more time and effort than training the network. The features are chosen by the designer based on its own knowledge and experience or the knowledge of an expert on the field of the problem. In most cases it is usual to find redundant or ineffective features, if they exist, and try to eliminate them (feature selection) as this would reduce the complexity and training time of the final system. Furthermore, sets of features that are most significant can be determined by comparative analysis.

Specific to the design of a neural network system the following tasks are necessary:

(c) Selection of an ANN type and architecture: As already mentioned at the beginning of the section, the architecture or topology of the network depends on the problem and the nature of the data. For example, a feedback architecture is usually required when the data is time depended and each pattern may require as input the output generated from the previous training example. Feedback NNets are usually more difficult to train than feed-forward NNets while the latter type are the most often used in practical applications. This is because feed-forward NNets usually produce a response to an input quickly and can be trained using a wide variety of efficient conventional numerical methods in addition to algorithms developed by Neural Network researchers.

Other issues closely related to the network topology include the number of hidden layers and hidden units to be used. In a wide variety of applications a linear or generalized linear model can be sufficient for developing a good classification system. In that case no hidden layers will be needed. However, in applications where a nonlinear model is needed, an MLP with one hidden layer with arbitrary large number of units typically suffices for a good approximation. The optimum number of hidden units depends on the number of input features, the size of the training set, the amount of noise present in the data, the architecture and the choice of functions and parameters in the algorithm. Although a lot of attempts have been made in order to determine a general 'rule of thumb' that give the most appropriate number of hidden units to be used for training the network [Sarle, 2000], none of them can be considered reliable enough or true for any situation. Among approaches that attempt to help with this problem is the use of early stopping.

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(d) ANN training, testing and validation: Designing and training an ANN also involves a minimum of three sets of independent input/output vector pairs representative of the process. This is part of a method known as early stopping, which is usually employed in order to prevent over fitting on the sample data and improve generalization.

#### **Complexity & Generalization Performance of an ANN**

The complexity of an ANN mainly depends on the number of adaptable parameters (weights and biases) in the system. The level of complexity can greatly affect the overall performance of the system. MLPs are often used for classifying data in a high dimensional feature space by defining a decision boundary between the different classes sampled in the feature space. Generally, the higher the complexity of the MLP being trained the higher the non-linearity of the decision boundary. If the MLP's complexity is larger than the optimum needed, then the boundary formed is sensitive to noise and over fit to the training data giving poor generalization performance (classification of unseen data). Lower complexity of the MLP than the one needed for the task will result in the opposite effect of over fitting, under fitting giving again poor generalization performance. This is because the system is unable to form the decision boundaries needed to completely separate the classes. For the trained MLP to classify as accurately as possible new, unseen data, an optimum complexity must be found. There are several methods that can be used at different stages of the above mentioned process in order to find a near optimum complexity. As already mentioned earlier, in the data pre processing stage, both the feature extraction and feature selection are significant factors in the training of an ANN since they can determine the number of input features to be used for the design and therefore directly affect the complexity of the network. For the training of the network, also a number of different techniques could be used in order to try and increase its generalization performance. These may include early stopping, cross-validation, and varying the size of the training data that must be a representative sample of the 'population'.

#### **Feature Selection**

In many real-life problems, features relevant to the problem are unknown. Therefore, in feature extraction it is usually the case where a large number of candidate features is chosen to better represent the domain of the problem. This results in many of the extracted features being either irrelevant or redundant, which in any case they do not affect the output of the network. However, the running time of the learning process is increased and in some cases, depending on the size of the training data set, learning might not work well without removing the unwanted features. An extensive analytical work on feature selection for classification has been presented in [9] while the work of Hall [10] with a number of publications on the subject also provides a good reference.

Feature selection methods search for the best subset of features through the competing candidate subsets according to an evaluation function. The selection is such that the classification accuracy does not significantly decrease and the resulting class distribution given the selected feature subset is as close as possible to the class distribution given the whole feature set. Searching for the best feature subset is an exhaustive procedure even for a medium-sized feature set. Over the past few years, a number of search algorithms have been

designed to prevent an exhaustive search of subsets and reduce computational complexity. A typical feature selection method involves the following tasks:

- 1. Generation of next candidate subset
- 2. Evaluation of generated subset
- 3. Stopping criterion
- 4. Validation of selected subset

A number of generation (or search) and evaluation algorithms exist. The most widely known generation procedures include the Branch & Bound algorithm [82], RELIEF [83], RELIEF-F [14], and the wrapper method [13]. Branch & Bound does a complete search through the feature subsets, but avoids an exhaustive search by exploiting the mono tonicity principle of a monotonic evaluation function. The rest of the above mentioned methods use a heuristic search where generation of subsets is incremental (increasing or decreasing). Other well-known heuristic approaches include the Sequential Forward Selection (SFS) and Sequential Backward Selection (SBS). SFS starts from an empty set and in each iteration generates subsets by adding a feature selected by an evaluation function, while SBS works backwards, i.e. it starts from the complete feature set and in each iteration generates a subset by discarding a feature selected by an evaluation function.

The evaluation function basically determines the outcome of the feature subset selection, since each function uses a different measure in order to determine whether a feature or a subset of features will be selected or rejected. Feature selection methods are grouped into two categories: filter methods which are independent of the inductive algorithm that will use the selected features and wrapper methods which use the inductive algorithm as the evaluation function [10]. Based on [9] different types of evaluation functions use one of the following measures: distance, uncertainty, dependence, consistency and classifier error rate, with the latter being used by wrapper methods.

Feature sub set selection is a major design issue not only for Artificial Neural Networks but for any other machine learning algorithm that might be used. In a comparative study between different algorithms it might be necessary and simpler to choose a filter method as this is independent of the inductive algorithm and might give results faster. Alternatively, the use of a wrapper method might provide additional information to be used for the comparison between the algorithms under consideration.

## **Early Stopping**

This technique is used for improving the generalization of a neural network during training and preventing it from over fitting. It achieves that by splitting the available data into three subsets which are used separately for training, validation and testing. These sets are used in the following manner: At each iteration through the training set, the ANN runs a test over the validation set; this is done iteratively while the performance of the network continues to improve. When the performance does not show further improvement with more iterations then the training is completed and the ANN runs a test over the test set. The result gives the final performance of the classifier.

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The basic concept is that the performance of the ANN against the training set will continue to improve with more training, and this is also true for its performance against the validation set. However, if the ANN starts over fitting the training set, its performance then against the validation set will start to decrease. Therefore, increase of the validation error (i.e. the error against the validation set) is indicative of poor generalization and can be used for stopping the classifier from further training. The weights giving best performance against the validation set can then be accepted as the set of weights that gives the ANN best generalization ability.

As the error surface is not always smooth, it is not certain at this point of the training if the validation error is the global minimum. So, it is common practice to continue training for several iterations (based on the judgement of the designer) in case the ANN performance against the validation set improves again. At the same time the configuration and set of parameters of the ANN that gave best results until this point are always stored. Because the validation set has been utilized during the training process, after the training is finalized, it is important to test the trained ANN against a separate set (the test set), which hasn't been used at all during training and will give an unbiased estimate of the generalization error of the network.

A practical alternative use of early stopping is to 'rotate' the validation set, i.e. divide the data (after a test set has been selected and excluded from it) into k subsets and use a different subset for validation and the remaining subsets for training, leading to k different combinations of training and validation sets. This approach has the advantage of avoiding over fitting or under fitting as a result of a bad split of the data into training and validation sets. Early stopping can then be applied k times and after each separate training has been completed, the generalization error can be estimated against the test set. As each different training has been tested against the same test set, the one that gave the best performance can be chosen.

Concerning the architecture of the ANN and the number of hidden units to be used, in early stopping, it is essential to use lots of hidden units to avoid bad local optima. There seems to be no restriction on the number of hidden units, other than that imposed by computer time and memory requirements [2].

#### **Cross-Validation**

Cross-validation may be a methodology for estimating generalization error supported resampling [15 - 17] and therefore the obtained results area unit usually used for selecting among numerous models, like completely different network architectures. In k-fold cross-validation, the info is split into k (approximately) equally sized subsets. The ANN is trained k times, whenever omitting one among the subsets, that is employed for testing. If k equals the sample size (i.e. there are a unit as several subsets as information examples) the strategy is named "leave-one-out" cross-validation (LOOCV). "Leave-v-out" cross-validation (LVOCV) involves effort out all potential subsets of v cases. The ultimate generalization performance of the system will then be calculable by averaging between the results obtained from every set.

Cross-validation is also wont to estimate the generalization error of a given model, or for model choice by selecting the model that has the littlest calculable generalization error. Hence, cross-validation can be wont to select the amount of hidden units, or a set of the input options (feature set selection). Moreover, this methodology is right for little information sets that can't be split into coaching and check subsets. Cross-validation permits for the complete information set to be used for coaching whereas it still provides freelance estimate of the generalization error.

#### Sensitivity versus Specificity

The performance of a binary classifier is typically quantified by its accuracy throughout the take a look at part, i.e. the fraction of misclassified points on the take a look at set. the employment of the general classification accuracy as associate in Nursing analysis metric is adequate provided the category distribution among examples is constant and comparatively balanced. Moreover, this analysis approach conjointly assumes equal error prices, i.e. that a false positive error is equally vital as a false negative error. Sadly, in real-life issues, these assumptions aren't forever true. Consequently, the performance of such systems area unit best represented in terms of their sensitivity and specificity quantifying their performance associated with false positive and false negative instances. These metrics area unit supported the thought that a take a look at purpose forever falls into one among the subsequent four categories: False Positive (FP) if the system labels a negative purpose as positive; False Negative (FN) if the system labels a positive purpose as negative; True Positive (TP) and True Negative (TN) if the system properly predicts the label. Within the following TP, TN FP, FN area unit won't to denote the amount of true positives, true negatives, false positives and false negatives, severally.

#### SUPPORT VECTOR MACHINE

Conventional neural network ways have incontestable difficulties finding a decent generalization performance as a consequence of the algorithms used for parameter choice and also the applied mathematics measures used for choosing the model with the "optimum performance" [18]. Convergence of a neural network to a worldwide minimum of the error operate involves the fine calibration of variety of parameters together with crucial the quantity of hidden units, the worth of the educational rate, etc. thanks to these difficulties, within the previous few years the scientific community has been experimenting with Support Vector learning. This less dimmed learning technique was recently introduced and has started receiving hyperbolic attention as a result of the easy concepts it's supported and also the high performance it's incontestable in sensible applications.

Support Vector Machines (SVMs) were initial introduced by Vladimir Vapnik between the late seventies and early eighties [19] and that they are supported the Structural Risk stepdown (SRM) principle from applied mathematics learning theory [20]. In antithesis to the Empirical Risk step-down (ERM) principle that is employed by neural networks to attenuate the error on the coaching knowledge SRM minimizes certain on the take a look at error, therefore permitting SVMs to generalize higher than standard neural networks [18]. excluding the matter of poor generalization and over fitting, SVMs additionally address the issues of potency of coaching, potency of testing and rule parameter calibration [21], issues oftentimes encountered in artificial neural network ways.

SVMs were developed to unravel classification issues and initial work was centered on optical character recognition (OCR) applications [22]. Some recent applications and extensions

of SVMs embrace isolated written digit recognition [23], visual perception [24], identification [25,], face detection in pictures [26,27] and text categorization [28]. All of the on top of cases are samples of SVMs used for classification. However, SVMs have additionally been planned and applied to variety of various varieties of issues together with regression estimation, novelty detection, and resolution of inverse issues. This can be as a result of the success of the tactic and also the got to adapt it to specific issues. In regression and statistic prediction applications, SVMs are compared to variety of competitor ways and their generalization performance was found to either match or be considerably higher than these ways [29, 20]. The employment of SVMs for density estimation [31] and ANOVA decomposition [32] has additionally been studied. Relating to extensions, the fundamental SVMs contain no previous information of the matter and far work has been done on incorporating previous information into SVMs [34]. Though SVMs have sensible generalization performance, they'll be terribly slow in take a look at section, a tangle addressed in [33,37]. Recent work has generalized the fundamental concepts [35, 36] and shown however these concepts are often incorporated in a very wide selection of alternative algorithms.

In the literature the term Support Vector Machine has been accustomed describe classification victimization support vector ways whereas the term Support Vector Regression Machine has been accustomed describe regression with support vector ways. During this thesis the term support vector machine (SVM) can ask support vector ways used for either classification or regression and also the terms Support Vector Classification (SVC) and Support Vector Regression (SVR) are going to be used for specification.

The sections that follow provides a transient description of the fundamental ideas of applied mathematics learning theory associated structural risk step-down followed by an introduction to SVMs within the settings of each classification and regression. For added material and a a lot of elaborated description of SVMs one will ask the works of V. Vapnik [19, 20], C. Burges [38], and A. Smola [34,36].

#### **Statistical Learning Theory**

Generally, for a given learning task, with a given finite quantity of coaching knowledge, the simplest generalization performance are going to be achieved if the proper balance is reached between the accuracy earned on the actual coaching set, and therefore the ability of the machine to be told any coaching set while not error, that is, its capability. A trained machine with very large capacity will over fit on the training data and will be able to identify only previously seen examples. While a machine with very small capacity will not be able to identify even previously seen data, i.e. learning of the training data will be incomplete. Neither can generalize well and therefore, the relation between the capacity and the performance of a learning machine must be controlled to achieve the right balance.

#### **Empirical Risk Minimization**

Suppose, for the case of two-class pattern recognition, l observations are given. Each observation consists of a pair: a vector  $xeR^d$ , i = 1, 2, ..., l and the associated label  $y_i$ , given by the source of information. Ultimately, the task of a learning machine is to estimate a function  $fa: R \rightarrow \{\pm 1\}$  using these examples, such that  $f_a$  will correctly classify unseen

examples (x, y). So, assuming that there exists some unknown probability distribution P(x,y) drawn from the given data, the aim is to estimate the function  $f_a(x) = y$  for examples (x,y) that were generated from the same underlying probability distribution P(x,y) as the training data. Actually, the learning machine can be defined by a set **F** of possible mappings  $x_i \rightarrow f_a(x)$ , where the functions  $f_a$  themselves are labelled by the adjustable parameters. The machine is assumed to be deterministic: for a given input x, and choice of a, it will always give the same output  $f_a(x)$ . A particular choice of generates a trained machine. As only the training data is given, a measure that could be used to decide which of the possible functions is preferable, is the training error or the empirical risk  $R_{emp}[f_a(x)]$ , which is defined to be the measured mean error rate on the training set (for a fixed, finite number of observations).

 $R_{emp}\left[f_{\alpha}\right] = \frac{1}{2l} \sum_{i=1}^{l} |y_i - f_{\alpha} x_i| \qquad (1.5)$ 

 $R_{emp}$  [ $f_{\alpha}$ ] is a fixed number for a particular choice of and for a particular training set  $(x_i, y_i)$ . The quantity  $y_i - f_{\alpha} x_i$  is called the loss and for the case described here it can only take the values  $\{-1\}$  and  $\{+1\}$ .

#### **Structural Risk Minimization**

VC (Vapnik-Chervonenkis) theory, a part of Statistical learning theory, shows that the set of functions **F** where is chosen from must be restricted to one which has a capacity that is suitable for the amount of the available training data. To do so, VC theory introduces bounds on the expected risk that depend on both the empirical risk and the capacity off. The minimization of these bounds leads to the structural risk minimization principle. According to this principle, for all the functions in **F** (i.e. for any *a*) and l > h with a probability of at least  $1 - \eta (0 \le \eta \le 1)$ , the following bound holds:

$$R[f_{\alpha}] \leq R_{emp}[f_{\alpha}] + \sqrt{\frac{h\left(\log\left(\frac{2l}{k}\right) + 1\right) - \log\left(\frac{\eta}{4}\right)}{l}}$$
(1.6)

The parameter is a non-negative integer called the VC dimension, which is defined as the largest number of points that can be separated in all possible ways using functions of the given set. In effect, the VC dimension provides a measure of the notion of capacity. The right hand side of (6.6) is a bound on R an( $f_{\alpha}$ ]holds only with a certain probability. The second term of this bound is called the VC confidence which is a monotonic increasing function of *h* for every value of *l*. This bound is independent of P(x,y), and if *n* is known, it can be easily computed. Conversely, the left hand side is difficult to compute. Thus, given some selection of learning machines whose empirical risk is zero and choosing a fixed, sufficiently small *n*, one must choose the learning machine whose associated set of functions **F** has minimal VC dimension. This leads to a better upper bound on the expected risk. In general, for non-zero empirical risk, one wants to choose that learning machine which minimizes the right hand side of equation (6.6). This is the essential idea of SRM.

#### **Support Vector Classification**

Having introduced the basic concepts of statistical learning theory, the basis needed for describing support vector machines is set. In the previous section, based on a binary classification case, it is shown that one needs to find a class of functions whose capacity can

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be computed in order to design a learning machine. Vapnik and Chervonenkis in [39, 40] considered the class of hyper planes

 $w.x + b = 0, w \in \mathbb{R}^d, b \in \mathbb{R}$ (1.7)

Corresponding to decision functions

$$O(x) = sign(w.x+b)$$
(1.8)

And represented the Generalized Portrait rule for constructing separating hyperplanes from empirical knowledge. This learning rule was projected for severable issues and it's supported the actual fact that among all potential separating hyper planes there exists a novel one with most margin of separation from the categories (a best margin hyper plane) and also the capability decreases with increasing margin





#### CONCLUSION

In this paper introduction to different type of biomedical image classification techniques are introduced and special focus on support vector machine. The paper also describes how classification accuracy can be achieved depending on the changes and other neural approaches. Neural when combined with fuzzy logic also gives an efficient classifier. The classifiers described in this paper categorize the image as normal and abnormal and present the location of tumour via clustering. The manual procedure that pathologist choose for diagnosis is microscopic detection which is often time consuming and causes fatigue to them, hence this proposed system is quite beneficial . But there are several forms in which a tumour is categorized depending upon the size and location of tissues inside the brain. Types of brain images like benign and malignant types and their features are discussed.

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# A TECHNICAL REPORT ON CHEMICAL VARIATION IN LIMESTONE DEPOSIT OF RAJASTHAN & ITS UTILITY IN DIFFERENT INDUSTRIES

Aijaz Mohammed\*

# ABSTRACT

Limestone is a versatile mineral having the largest and widest industrial applications; it is also important building material. Rajasthan has large number of limestone deposit in possession. This paper discusses the distribution of limestone quarrying in Rajasthan and the application of limestone in different sector of economy.

**Keywords:** Alkali, calcium carbide, cement, Fertilizer industry, Iron and Steel industry, Limestone, Rajasthan, Sugar industry, Vindhya.

# **INTRODUCTION**

Limestone is a versatile mineral having the largest and widest industrial applications; it is also important building material. The important industries where its uses are made are as follow: cement, chemical, metallurgical, sugar, glass, ceramics, paper, and fertilizers. However cement is largest consumer of limestone where it is principal raw material. Almost 1.5 tonne of limestone is required for each tonne of cement produced.

Rajasthan has been fortunate enough in possessing large number of limestone deposits in 25 out of 32 districts of the State. However, important districts well known for the cement grade limestone deposits are Chitttorgarh, Udaipur, Sirohi, Sawai Madhopur, Bundi, Ajmer, Alwar, Banswara, Bhilwara, Jodhpur, Jhunjhunu, Kota, Nagaur, Pali, Sikar, Jaipur and Jaisalmer.

Although limestone rocks are widely occurring in the state, the same are not alike. It is associated with varying quantities of impurities like silica, magnesia, alumina, iron oxide, iron sulphide etc. The absence and presence of such impurities determines the use of limestone in an industry.

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## LIMESTONE FORMATIONS IN RAJASTHAN

Limestone deposits of Rajasthan can be grouped in to the following geological formations:-

a)	Aravali Super group	: Lunavada group, Udaipur group
b)	Delhi Super group	: Raialo Group, Ajabgarh Group
c)	Vindhyan Super group	: Lower Vindhyan,Upper Vindhyan
d)	Mesozoic	: Jurassic
e)	Tertiary	: Eocene

Limestone deposits of Aravali Super group representing the oldest sedimentary rocks are occurring in the districts of Banswara, Dungarpur and Sirohi. In Banswara district, these have been located near Bhamria-Kalinjara, Umral-Talwara Kushalpura. Bari – Lalpura, Khamera-Bhungra, Narwali, Patan, Bhimkund, Surwani-Kelamela and Loharia in Dungarpur district. it is found near Sabia in Sirohi district. Aravali, limestone are found near Bhatana, Badechi, Basari, Selwara, Perwa-Serwa and Sibagaon. All these deposits have a general characteristic of being small and scattered having reserves of 15 to 40 million tonnes. These are located in the tribal belt of Rajasthan and are not connected by rail. Their chemical composition is quite suitable for cement manufacturing as they contain more than 45 % Calcium Oxide( CaO), less than 3% Magnesium Oxide(MgO) and 2 to 15% Silicon Oxide(SiO<sub>2</sub>), since they belong to the oldest sedimentary rocks, they are crystalline in nature due to metamorphic which has resulted in these being utilised as marble. One medium scale cement plant was established in Banswara district at Bari- Lalpura is closed for last few years because the limestone deposit lies in the forest land. From Banswara, limestone is also, supplied to various cement plant located at Dahod in the neighbouring State of Gujarat. In Sirohi district also limestone is supplied to various mini cement plants located in the same district and also to the major cement plant as sweetener.

Limestone of Raialo group are crystalline in nature and geologically come under the category of marble, this group represents the famous marble belts of Makrana and Rajnagar however, some deposits of this group which are not suitable for marble mining have been found to be good cement grade limestone. Such deposits mainly occur in Udaipur and Pali districts. In Udaipur, the state government had investigated limestone deposits near Daroli-Manderia block and have found proven reserve of nearly 90 million tonnes. Based on this estimate, a cement plant is working since 1970. Other small deposits are located in Udaipur and to other industries, has recently marble mining has also been started in this belt.

In Pali district, limestone of Raiaola group occurs near Ras and Deoli-Jhillian-Guria villages. A small part of limestone deposits near Ras was investigated by the department in 1962-64 which establish reserves of 45.37 % million tonnes up to 18 MTS. Depth contains 45% CaO and less than 2% MgO. This deposit is located about 20 km. west of Beawar and runs almost 30 kms. Strike length and is most suitable for cement manufacture. Two cement plants are already coming up in this belt. (DLF & Shree cement). Besides, five more blocks have been recently notified for grant of prospecting license.

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In southern extension of Ras- Limestone deposit, outcrops are seen near Gurla Rly station for about 8.8 kms. sStrike length up to Deoli and Jhilan villages. Nearly 12.30 million tonnes reserves were estimated over a small part of this area which is expected to be enhanced by further prospecting.

The limestone belonging to Ajabgarh group of Delhi Super group is exposed at many places, along the central axis of Aravali range starting from south western corner in Sirohi district, and passing through Udaipur, Pali, Ajmer, Jaipur, and Sikar districts to Jhunjhunu district in the northern corner of state. Most of the deposit is in the vicinity of Delhi- Ahmadabad line of western railway deposits in Sikar and Jhunjhunu district, are lying along in these districts which support major cement plants in Sirohi district at Pindwara and one near Beawar in Ajmer district and few mini tiny plants at Abu Road and Pindwara in Sirohi, Kotputli in Jaipur and in Sikar and Jhunjhunu districts. The limestone belt in Sirohi district runs for about 65 km. strike length from Amil in north to Siyawa-Abu Road in south. The limestone in general is grey in colour, hard, compact, crystalline, and fine to medium grained. On the basis of preliminary investigation carried by the State department. About 400 million tonnes of cement grade limestone may be available in this belt. Besides catering to the existing cement plant and lime kilns, there is further scope of establishing major cement plants near Pindwara based on the deposit and near Kotal-Kundal which has been recently notified for leasing.

In Udaipur district limestone deposits was investigated near Bikarni-Khajuria village in Kotra Tehsil. The area is about 40 km east of Sarupganj railway station on Delhi -Ahmadabad line. The limestone forms discontinuous and parallel to sub-parallel bands separated by schists and granites. Detailed exploration has established about 37.47 million tonnes reserves containing 48.33% CaO. A small deposit was also investigated near Hathun-Jaswantpura in Bhim Tehsil, which is about 12 kms southwest of Beawar railway station. A reserve of 30 million tonnes has been estimated in this area containing 40 to 50 % CaO. This deposit further continues towards Sheopura-Lulwa and may sustain a major cement plant.

### Vindhyan Limestone Deposit:

Vindhyan limestone deposits are most extensively found in the state in the district of Chittorgarh, Bundi, Kota, Jhalawar, Bhilwara, and Sawai Madhopur. These deposits at present sustain six major cement plant located at Chittorgarh, Shambhpura, Nimbhaera, Lakheri (Bundi), Sawai Madhopur, Kota and Morak (Kota). One more cement plant is in the stage of establishing very soon near Shambhupura. Some marginal cement grade limestone deposits are occurring near Gadola and Borkheri which may also sustain a cement plant with the help of sweetener.

Satur-Hapura deposits in Bundi district were prospected in detail by Cement Corporation of India which as established 70 million tonnes reserves containing 43% CaO. This deposit now falls along the newly constructed broad-gauge railway line but suffers from the problem of forest.

In Bhilwara district, a number of small deposits of marginal grade have been located near Laadpura, Biharipura, Hamedpura in Mandalgarh Tehsil based on which efforts have been made by M/s Zuari Agro industries to establish cement plant at Mandalgarh but suffers setback

due to forest. The other deposit near Mandiyardi-Patiyal with 30.78 million tonnes reserves is also promising for a mini plant but it may also need forest clearance.

In Milo-Julmi area of Kota district, reserve of 48. 70 million tons has been established by the department it which can further be enhanced by exploration to sustain a cement plant.

## Sojat – Bilara:

Gotan limestone belt is equivalent to Vindhyan Super group but has been given separate status under Marwar super group. This belt passing through Pali - Jodhpur and Nagaur district is the most important as it contains high grade limestone bands which are also used in chemical, sugar, metallurgy and Other industries besides white cement plants located at Gotan and Khairya Khangar. A Large number of minor mineral leases have been granted in this belt for limestone which caters to the need of various industries. Nagaur district has been reserved for SMS grade limestone but recently 4 blocks near village Tantwas was have been dereserved, where there is no potential of SMS grade limestone. These blocks required detail prospecting one major cement plant is likely to establish near Mundhwa for which prospective has been completed recently in the area.

In Jaisalmer district, limestone deposits of Jurassic and earlier ages have been located which are highly potential source of cement grade limestone. Near Jaisalmer reserve 15 million tonne has been estimated in Sanu- Khuiala area, reserve of 854 million tonnes of chalky limestone has estimated which lies bneneath SMS grade limestone. This chalky limestone has been found suitable for cement manufacture by NCCB. It will open new avenues for Industrial development of this desert area. One area near Minyor ki Dhani is already in the process of sanctioning the mining lease for cement plant. Proposals have been made for two more areas near Tulsiram ki Dhani and Khinya Khimsar.

Total reserves of limestone of all grades in Rajasthan have been placed at 9000 million tonnes, which is almost 13% of the all- India figure of 69353 million tonnes. Thus, Rajasthan is an important state from the point of limestone deposits.

## **Specification of Limestone for Different Industries:**

Limestone is calcareous sedimentary rock composed of mineral calcite (CaCO<sub>3</sub>) which upon calcinations yield lime (CaO) for commercial use. Cement and Iron & Steel industries are the major consumer of limestone. It is also used in Chemical Industries like calcium carbide, bleaching powder; soda ash precipitates, calcium carbonate etc. Besides, it is used as fluxing material in producing Ferro-alloy, pelletisation plants, foundries and in the production of sponge iron as refining material, in the production of sugar, as additive in Fertilizer industry, as a coating material in glass industry and in the cooking of rags and grass in the paper industry.

Present status of specification of limestone for different end use Industries and the likely future Trends have been discussed. The detailed specifications of limestone required by various industries are given below:

# **Cement Industry:**

Limestone containing about 45% CaO and above is usually preferred for the manufacture

of cement. Magnesia contained in the stone should it be less than 3% although as high as 5% MgO is used by the industry. The proportion of  $Al_2O_3 + Fe_2O_3$ ,SiO<sub>2</sub> should be 1:2:5 magnesia, Sulphur and phosphorus are regarded as most undesirable impurities. The presence of phosphorus and P<sub>2</sub> O<sub>5</sub> more than 1% slows down the setting time of Portland cement. The cement industry in India in general prescribed the following specification of limestone CaO of 42%, Al<sub>2</sub>O<sub>3</sub> within 2 to 4%, Fe<sub>2</sub>O<sub>3</sub> within 1-2%, SiO<sub>2</sub> within 12 to 16% and MgO 4% (Max).

# Iron and Steel industry:

Limestone is used in this industry both in the blast furnace and steel melting shop. It has two basic functions, first to lower the temperature of the melting and second to form calcium silicate by combining with silica of the iron ore that comes out as slag.

**Blast Furnace:** Specification of limestone in various steel plants in India for use in blast furnace are given as follows:

Plant size	CaO	MgO	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	T.I (Total insolubles)
BSP +50mm	42%	8%			6.5%
10%(max)	±1%				±1%b
-25%mm 5					
BSL -25mm	45%	6%	5%		
5%(Max)+80%					
5%(Max)					
RSP+50mm	44%			2%	
10% (Max)					
DSP -25mm	45%		7.5%		12%max
10%(Max)					
+75%mm					
10%(Max)					
IISCO +75mm	46%				
10%(max)					
-25%mm					
10%(max)					
TISCO -75mm	6% max		10%	10%	11%(max)
+25mm O/s					12%(max)
10% up to					
100mm u/s up					
to 10 %					

# **Steel Melting Shop**

For this purpose good fluxing limestone low in constituent such as silica, alumina, sulphur and phosphorus is required. The limestone should be dense, massive preferably fine grained, compact and non-fritting on burning. The specification of limestone required by the Steel plant in India for SMS for purposes given below

	Plant size	Cao	Mgo	Sio2	Al2O3	T.I (total insolubles )
BSP		49%	4%(Max)			5%(Max)
a)O.H	+50mm			1.8%	1.7%	
	5%(max)					
	40-80mm	53%	2%(Max)			
b)L.D	+5%					
BSL(LD)	-30mm	50%	3.5%(Max)			
	5%(Max)					
	+60mm					
	5%(Max)					
RSP	+80mm	51%				5%
	10% (Max)					+-1.5%
	-40mm					
	10%(Max)					
DSP	75-125mm	48%		3.5%		5%max
	+125mm			(Max)		
	10%(Max)					
	-75mm					
	10%(Max)	500/		40/		
lisco		50%		4% (max)		
	+125mm 5%)			(IIIax)		
	-75mm					
	10%(max)					
TISCO		53%	2%(Max)			4%(max)
a)OH	-75mm					
	+35mm					
	-70mm to35mm					
b)L.D.	5 %(Max)		2%(Max)			1%(max)

from the above it is seen that limestone LD surface LD furnace must be of high purity with low silica content as far as possible some plants are insisting on as low as  $0.5 \text{ SiO}_2$ . The ISI(IS:10345-1982)has prescribed the under mentioned guidelines for flux grade limestone for use in steel plants.

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Characteristics	Grade I (For use in lime manufacturing )	Grade II (For use in steel making)	Grade III (for use in iron making)
CaO	52% Min	50% Min	42% Min
MgO	2% Max	3% Max	9% Max
Acid insolubles	2% Max	4% Max	10%Max
Preferred Size	-	25-60 mm	25-60 mm

The size ranges other than specified above shall be subjected to agreement between the supplier and the procedure.

# **Chemical Industries:**

Generally quick lime is used in the manufacture of calcium carbide. The calcium carbide manufacturers generally prefer lime containing 95% CaO (min) not more than 3% SiO<sub>2</sub> not more than 0.95% Phosphorus and other impurities should not exceed 2%. Though chemical composition is the guiding factor, the physical characteristics of the limestone are also very important. For the manufacture of bleaching powder also, fat lime containing CaO 95% above is required. Total Fe<sub>2</sub>O<sub>3</sub>+ Al<sub>2</sub>O<sub>3</sub>+MnO<sub>2</sub>Should be less than 2%, MgO should be below 2% and SiO<sub>2</sub> less than 1.5%. Bleaching powder is prepared by absorption of chlorine by dry hydrated lime. The hydrated lime should not contain more than 2% excess water. Iron and Manganese oxide leads to an unsuitability of the product and iron oxide tends to discolour the bleach material. Magnesia renders the bleaching powder. Limestone suitable for bleaching powder manufacturer can be advantageously utilised by alkali industry for the manufacture of Soda ash and caustic soda.

# **Sugar Industry:**

In sugar industry, lime is used for the clarification of the juice from cane and beets. Milk of lime 1% in volume of cane juice is added too preheated juice. Limestone to be used in sugar industry must be high in active lime (CaO 80% minimum), must be low in iron aluminium and silica etc. Magnesia should be less than 1%. Excess of silica is undesirable because it separates acid gelatinous precipitate which covers the sugar crystals and their growth and filtration. Magnesia is objectionable because magnesium carbonate is soluble in sugar juice. Presence of iron tends to colour the finished product. Following specification of limestone for use in the preparation of bleaching powder. caustic soda and calcium carbide and sugar.

Characteristics	Requirement in % by mass for				
	Bleaching Powder	Caustic Soda	Calcium Carbide	Sugar	
1.LOI	46.0	46.0	46.0	44.0	
2.SiO <sub>2</sub> (Max)	0.75	-	1.0	2.0	
3.Fe <sub>2</sub> O <sub>3</sub> (Max)	0.15	-	0.25	-	
4.CaO(Max)	54.0	53.0	54.0	50.0	
5.MgO(Max)	2.0	1.0	0.8	1.0	
6.Mn <sub>2</sub> O <sub>3</sub> (Min)	0.06	-	-	-	
7.CO <sub>2</sub> (Min)	42.0	42.0	42.0	41.0	
8.S(Max)	-	-	0.1	-	
9.P(Max)	-	-	0.01	-	
10.Al <sub>2</sub> 0 <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub> (max)	-	-	0.50	1.5	
11.SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> (Max) Fe203	-	3.0	-	-	

## **Glass Industry:**

Glass industry requires high calcium limestone CaCO<sub>3</sub> (94%). Combined CaCO<sub>3</sub> and CaCO<sub>3</sub> should be 97.5%. Iron and other colouring material like carbon are regarded as objectionable. Fe<sub>2</sub>O<sub>3</sub> should be up to 0.20% maximum. For colourless glass limestone should contain 08.5% CaC O<sub>3</sub>. Iron content as Fe<sub>2</sub>O<sub>3</sub> should not be more than 0.04% and for bottle glass Fe<sub>2</sub>O<sub>3</sub> up to 0.05% The ISI specification(IS:977-1973) for limestone for used in glass industries are as follows:-

1.Silica (SiO <sub>2</sub> )	2.5%
2.Total iron (Fe <sub>2</sub> O <sub>3</sub> )	
a) Calcite or Marble	0.05%
b) Limestone	0.10%
c) Dolomite	0.15%
3. Lime	53.0%
4. Total Lime and Magnesia	54.5%

# **Fertilizer Industry:**

The latest use of limestone introduced in the country in the manufacture of calcium ammonium nitrate fertilizer. Limestone is used as career. For this purpose limestone should contain  $MgCO_3 + CaC O_3 85\%$  (Min), SiO<sub>2</sub> 5%(Max) and acid insoluble 14%(Max).

The chemical requirements of limestone for use in foundries as per ISI specification (IS: 4140-1978) are given below:

Characteristics	Grade 1	Grade 2	Grade 3
Calcium oxide (CaO) Min	52	50	45
Silica (SiO <sub>2</sub> ) Max	1.5	3	5
Mixes Oxides R <sub>2</sub> O <sub>3</sub> (Fe <sub>2</sub> O <sub>3</sub> +Al <sub>2</sub> O <sub>3</sub> ) Max	1	1	2
Magnesium Oxide (MgO)	2	3	5
Insoluble Matter Max	0.5	1	2

## **Future Trends**

It is noticed that a rigid specification are prescribed in the Steel Industry for L.D grade limestone. The CaO content in limestone should be 52% (Min) and 1% SiO<sub>2</sub> (Max) besides the physical characteristic is important. It should not be non-decrepitating and should have low content of alkalis.

# Present status of classification of reserves of according to the industrial application:

In the mineral inventory by IBM, the Reserve of limestone are classified in the cement, BF, SMS and chemical grade taking into consideration:

(A) reported content CaO, Mgo and SiO2;(B) Judgements of the exploration agencies without any separate chemical analysis data and; (C) actual reported use where chemical analysis data has been taken as criteria with the following parameters:

Cement	CaO	42 to 45%
	MgO	5%(Max)
BF	CaO	42%(Min)
	CaO+MgO	48%(Min)
	SiO <sub>2</sub>	9%(Max)
SMS	CaO	48%(Min)
	MgO	3%(Max)
	SiO <sub>2</sub>	4%(Max)
Chemical	CaO	50%(Min)
	MgO	2%(Max)
	SiO <sub>2</sub>	2%(Max)

# Source of Data:

- Department of Mines and Geology, Udaipur, Rajasthan
- Geological Survey of India, Jaipur Office
- Cement Research Institute of India ,New Delhi
- Regional Training Centre, Nimbahera
- National Council for Cement and Building Materials, New Delhi.

# LITERATURE REVIEW ON MARKET ORIENTATION

Dr. Nirbhan Singh\*

## ABSTRACT

Market orientation is the generation of appropriate market intelligence pertaining to current and future customer needs and the relative abilities of competitive entities to satisfy these needs; the integration and dissemination of such intelligence across departments; and the coordinated design and execution of the organization's strategic response to market opportunities .Since 1990 research has been conducted by several scholars on market orientation since. The concept of market orientation has been used and implemented by many developed countries. Market orientation concepts have done a drastic change in different aspect of the business and prove beneficial in business performance. This paper comprehensively reviews the gist of these researches.

**Keywords:** Business performance coordinated marketing, customer focus, inter-functional coordination, Market Intelligence, Market Orientation, profitability objectives.

### INTRODUCTION

The review of literature is a major activity in research because it assists the researcher to find a broader and in-depth knowledge of the area of research in which he is working. The researcher also gets an idea about the statistical tools used by the past researcher in various incidents and situation faced by them. He finds different ways for conducting the research and finding the outcomes. The researcher realises the importance of theoretical knowledge to know the basic things related to the situation. He gets to know the gap that exist in the study through the review of literature. Such gaps are further studied by the researcher for investigation and analysis.

Market orientation is the generation of appropriate market intelligence pertaining to current and future customer needs and the relative abilities of competitive entities to satisfy these needs; the integration and dissemination of such intelligence across departments; and the coordinated design and execution of the organization strategic response to market opportunities.

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Since 1990, research has been conducted by several scholars on market orientation. The concept of market orientation has been used and implemented by many developed countries. Market orientation concepts have done a drastic change in different aspect of the business and prove beneficial in business performance.

## LITERATURE REVIEW ON MARKET ORIENTATION

Marketing orientation is one of vital ingredient in determining an organisation's success. Marketing orientation is more than simply "getting close to the customer". An organisation can be marketing oriented only if it completely understands its market. Customer information must go beyond research and promotional functions to permeate every organisational function. Marketing orientation is generally regarded as the implementation of the "marketing concept".

The marketing concept is a philosophy of doing business which puts the customer's needs at the centre of the organisation. The implementation of the marketing concept is the first and foremost a functional activity. Those organisations which engage in marketing purely as a functional strategy can be said to be marketing-oriented. However, when there is congruency between the functional level and the underlying organisation culture, when customer are the first priority of top management and when marketing strategy is a direct extension of corporate strategy, a market orientation exists. A market-oriented company develops and implements marketing strategy which is an operational interpretation of its basic business philosophy. In contrast, a marketing-oriented company merely implies the effective management of the marketing function, an activity which is typically localised within a particular division.

Market orientation was first defined within marketing literature as an organization-level culture comprising values and beliefs about putting the customer first in business planning. Since then, market orientation has been studied both as

- (1) A cultural phenomenon
- (2) As a set of behaviours relating to
- a) Organization-wide market intelligence generation through decision support systems, marketing information systems and marketing research efforts,
- b) Dissemination of the intelligence across functions in a firm, and
- c) Organization-wide responsiveness (actions) based on this intelligence (Kohli & Jaworski 1990).

Market intelligence covers both customers and competitors and market orientation has attracted a significant amount of academic and practitioner interest in the current marketing literature (Han, Kim & Srivastava 1998; Kohli & Jaworski 1990).

Market orientation is one of the five philosophies or orientations (the other four being production concept, product concept, selling concept and societal marketing concept) that guide the planning and organization of a firm's activities. In a competitive environment, marketing concept is considered to be a far superior guiding philosophy than the product, production and selling concepts. No doubt societal marketing concept is relatively of a recent origin and constitutes an improvement over the marketing concept, it is the latter which continues to hold

a sway over other concepts in both marketing literature and business speeches.

Understanding customers is a much debated area among business practitioners and academicians alike. In a rapidly changing world, customer-centric innovations are regarded as vital sources for attaining competitive advantage (Prahalad and Krishnan, 2008). For the last few decades, market orientation has remained a pivotal theme of published works not only in the marketing literature but in strategic management also. It lies at the core of marketing philosophy and has been one of extensively studied constructs in the marketing discipline since the early nineties (Stoelhorst and Raaij, 2004).

Lafferty and Hult (2001) expressed market orientation as execution of marketing concept. It reflects how organization demonstrates a customer-focused approach in their behaviours and culture (Deshpande, Farley & Webster, 1993; Kohli, Jaworski & Kumar, 1993; Narver & Slater, 1990). Building on the initial research by Kohli and Jaworski (1990), Narver and Slater (1990) and Deshpande et al (1993), significant progress has been made in conceptualization and measurement of market orientation and its impact on business performance. According to Gray, Buchanan and Mallon (2003), the management of market intelligence by employing distinct dynamic capabilities of the organization results into superior organizational and financial performance.

For a long time, marketing concept remained enshrined only in terms of customer orientation. But later on, other constructs such as competitor orientation, inter-functional coordination and profit focus also got added to it (Houston, 1986; Kohli and Jaworski, 1990; Kotler, 1972; Levitt, 1960; McNamara, 1972; Narver and Slater, 1990). The idea underlying addition of these additional constructs was that unless a firm aims at delivering customer satisfaction in a way superior to competitors and adopts it throughout the organization, with due regard to profitability of its operations, customer orientation is unlikely to come up as a commercially viable competitive tool to withstand market challenges. Especially, the construct "inter-functional coordination" came to be recognized as an essential ingredient for the successful implementation of marketing concept, with the belief that much of the satisfaction to the customers is unlikely to materialize unless all the departments in the organizations imbibe the spirit of marketing concept and gear up themselves to work harmoniously with other departments for delivering customer satisfaction.

Marketing oriented firms always work around the marketing function. Now, firms can understand the importance of the marketing concept and has taken the appropriate steps to improve the firm's orientation towards customers, markets and consumers. It is important to understand that a firm can be market oriented and yet have a very small marketing department or none at all. A firm can have whole panoply of marketing activities and fail in its aim to come close to its customers. Marketing oriented firms can be very successful without having a plethora of individual or departments bearing titles associated with marketing tasks and subtasks.

The contribution of Kohli and Jaworski (1990) was substantial at least in three important ways (Silkoset, 2004). First, they developed a link between market orientation and positive financial business performance. Second, market orientation could be investigated as an

observable behaviour. Third, through minimally abstract constructs and measures, they presented implications for the practitioners as well.

Jaworski & Kohli(1993); Slater & Narver(1994) found multiple organizational factors which contributed substantially to make organizations more market oriented. Jaworski and Kohli (1993) found that senior management factors, interdepartmental dynamics and organizational systems could act as drivers or hindrances for the organizations in their market orientation. The role of senior management was found to be critical in shaping organizational values to promote and reinforce behaviours necessary to serve the current and future needs of customers, better than their key competitors. Besides top management reinforcement, their commitment of continuous communication of specific guidelines to be market-oriented was considered mandatory to encourage organizational employees, in order to create, disseminate and effectively respond to market intelligence. Top management proved to provide a great deal of support in their commitment to innovation and responsiveness. However, their support could lead to organization-wide derailment of the process of market orientation. Interdepartmental dynamics such as conflict among organizational departments and interdepartmental connectedness were found to be detrimental or beneficial, respectively to execute the business philosophy, represented by marketing concept.

Harris and Piercy (1998) identified a negative relationship between conflicting behaviour within an organization and the degree of market orientation. Pulendran, Speed and Widing II (2000) concluded that interdepartmental conflict inhibited the ability of an organization to coordinate activities and act as barrier to focus on market dynamics. On the contrary, Interdepartmental connectedness enhanced the development of market intelligence and sharing across the entire organizational departments (Kohli & Jaworski, 1990).

Formalization may actually expedite the processes of external information gathering and its dissemination across the organization to effectively respond to the requirements of market. Covin and Slevin (1990) found that higher the formalization of organizational decision making, the greater would be the level of entrepreneurship. However, Jaworski and Kohli (1993) did not confirm relationship between formalization and organizational market orientation. They concluded that organizational dimensions, such as formalization and centralization hinder the generation and dissemination of market intelligence and organizational response design. When employees' roles, their authority relationships, communications and sanction processes are standardized, then it may hamper the organizational efforts to be market oriented. Same thing happens when decision making authority in not delegated across the organization and employees' participation lacks in decision making. Walter, Lechner and Kellermanns (2007) commented that centralization tends to slow down the development, dissemination, and application of market knowledge. Reduction in centralization was reported to be associated with growing uncertainty in external environment of organizations (Davis, Morris & Allen, 1991).

Market orientation refers to a business behaviour that ensures that products and services are developed such that they meet customer needs and expectations (Grönroos, 2006). In this connection, a market-oriented firm shall involve the customer in designing the marketing mix in order to provide customer value. In support of this argument, Chen and

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Quester (2009) have described that both the implementation of customer-centric thinking in marketing and customer value creation are critical for achieving a positive business performance (Alhakimi and Baharun, 2009).

Market orientation can be described as part of a firm's culture that supports adaptive and changing organisations in order to be able to offer greater value to the firm's customer. Narver and Slater (1990;p. 21) assert that market orientation can be described as a component of organisational culture that most effectively creates the necessary behaviours for the creation of superior value for buyers and superior performance for the business. Thus, being 'market-oriented' is expected to bring a firm the ability to produce superior customer value in the long run (Morgan and Strong, 1998).

Based on these views, Pelham and Wilson (1996) argue that a market oriented culture is the main source of competitive advantage for current business firm's, simply because such firm's are capable of understanding the nature of customer-driven value creation and developing a market-oriented culture takes much effort and time. Indeed, a firm that aims at being 'market-oriented' needs to follow as

- 1. Develop a working self-assessment and adjustment system.
- 2. Systematically collect information about customers and competitors in the marketplace and analyse them in detail.
- 3. Disseminate the resulting knowledge across the entire organisation.

Narver and Slater (1990) suggested that research must be replicated in diverse cultures to boost conviction in nature and power of market orientation and its antecedents. Hence, the market orientation model, proposed by Kohli and Jaworski (1990) to determine which organizational factors could contribute in making organizations, operating in diverse industries, more market oriented. The exploration of organizational factors will facilitate leadership of organizations in designing and implementing business practices and processes, aimed at becoming more oriented towards market which would result into improved organizational effectiveness and sustained competitive advantage.

According to Kohli and Jaworski (1990), this operative approach provides an enterprise with a group of actions that can contribute to the creation of superior customer value. Kohli and Jaworski (1990) constituted a major breakthrough in providing an operational definition of the concept to facilitate its effective implementation by the business firms. Later researchers like Narver and Slater (1990), Pelham and Wilson (1996), and Appiah-Adu and Singh (1998) conducted the research and proposed alternative frameworks to operationalize marketing concept. These researchers observe that market orientation is the creation of a superior customer value through systematic acquisition and analysis of information and development of knowledge about the target market, consisting of customers as well as competitors and other environmental factors. The collection of market information is to be followed by systematic use of such knowledge for the coordinated creation of sustainable superior customer value.

According to Slater and Narver (1994), the construct of market orientation is composed of the three complementary dimensions, viz. Customer orientation, Competitors orientation and Inter-functional coordination. Each of these serve in conjunction with one another for the sake of long-term profitability. Customer orientation, as the central dimension of market orientation, necessitates the creation of an organisational climate where every employee places the objective of customer satisfaction first and foremost in his or her day-to-day activities. Competitor orientation involves active monitoring of all existing and potential competitors in the marketplace vis-a-vis benchmarking and competitive intelligence in order to differentiate the firm and create sustainable competitive advantages through this enhanced knowledge. Finally, the need for disseminating marketplace information and developing a system of active coordination across different organisational functions departments is necessary for the establishment of a successful market orientation.

Slater (1996) highlighted the following two key features of market oriented firms:

- 1. Learning about current and latest needs of customers.
- 2. Proactively implementing countermeasures against the anticipated or actual actions of competitors.

Market-oriented businesses seek to understand customer's expressed and latent needs and develop superior solutions to those needs. (Kohli and Jaworski, 1990; Day, 1994; Slater and Narver, 1995).

Baker and Sinkula (1999) describe the market orientation and learning orientation as two different organisational characteristics of market information processing activity. In spite of their arguments, other such as Farrell (2000), Slater and Narver (1995) assert that market orientation is positively related to the learning orientation. Due to the fact that a learning-oriented firms have the ability to learn and use the knowledge garnered in the environment in order to effectively operate as market oriented enterprise. Further, the programmatic and market-back approach of market orientation plays important role in learning (Narver *et al.*, 1998).

Market orientation is the core of the marketing literature and also considered as the activity of the organisational culture which concentrates on the performance and market activities quite sensible. In the market orientation, the market knowledge and information are using it plays a crucial role in getting competitive advantage. (Despande *et.al*, 1993; Kohli & Jawarski; 1990, Narver & Slater, 1990).

Research on marketing orientation has the main role in forming the thought and attitude toward the marketing literature (Helfert *et al*, 2001). Market orientation and the factors which affect are affected by have been investigated and examined in many research. In relation to issue it can be referred to cases such as new product development (Shepherd, 2011), selling increasing, income increasing, the high level of employees satisfaction, commitment and trust, service presentation to the customer (Narver & Slater, 1993), privileged firm's performance (Kohli & Jawarski, 1993) and the best consequence of market orientation with respect to innovation, the product advantage and inter-segment team working (Atuahana-Gima, 1996). On the other hand, market orientation conducts the firm to more innovation and guides its success (Farrel & Oczkowski, 1997 quoted by Sheppard, 2011).

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Market orientation framework was recognized and introduced in the beginning of the 80s and 90s (Shepherd, 2011; Day 1994). Some of the researchers have referred the root of the market orientation concept to Adam Smith and his well-known book "The *Wealth of Nations*". Nonetheless, most of the researchers of the marketing have referred the root of the market orientation to Peter Drucker (1954) (Shepherd, 2011). In the beginning of 1990s, market orientation was considered equivalent to the marketing concept (Shapiro, 1988; Webster, 1988).

Drucker (1954) and Levitt (1960) both argued that marketing was the responsibility of top management and that a customer focus should be the top priority of the firms, the rise of long range planning in the 1960s and 1970s. With its attendant focus market share and market growth rates, diluted the original emphasis on the customer (Webster, 1988).

Webster finds that when the practice of strategic management supplanted long range planning in the 1980s, top manger began to rediscover the marketing concept. The strategic management focus on sustainable competitive advantage was fundamentally based on serving the needs of specific sets of customers better than competitors, consequently there was a renaissance of the marketing concept as more manger recognised a market orientation as the organisational culture that most effectively and efficiently creates the necessary behaviours for the creation of superior value for buyers and thus, continuous superior performance for the business. (Narver and Slater, 1990)

Miller and Toulouse's study (1986) demonstrated the influences of small firm strategy, firm structure and CEO's personality on firm performance.

Kohli and Jaworski (1990) helped to develop our understanding of the concept of market orientation and the behaviours that implement the marketing concept. They provided a theoretical foundation for the expectation that this orientation should lead to higher firm performance.

Narver and Slater (1990) provided the first empirical evidence linking market orientation and profitability in the strategic business units of a large firm. According to them, market orientation composed of three behavioural characteristics; Customer orientation; understanding the potential customer needs in order to create an added value for him on a continuous basis. Competitor orientation; knowing the strength and weaknesses as well as capabilities and strategies of key competitors. Inter function coordination; coordinating use of the firm recourses for creating high added value to forget customers.

Jaworski and Kohli (1993) also documented the link between market orientation and overall firm performance for large firms.

Pelham and Wilson (1996) argue that a marketing-oriented firm culture is a strong source of competitive advantages based upon:

- 1. The scarcity of firms with a market-oriented culture.
- 2. Such firm's strong ability to understand the nature of value to the customer.
- 3. The difficulty of instilling market-oriented norms.

4. The difficulty of understanding the causal implication of these norms and behaviours, however, these researchers also emphasize the importance of understanding the wide range of determinants of small firm performance, including strategy, firm structure and the industry environment.

Narver and Slater (1990) propose a potential explanation that the market orientationperformance relationship might be contingent on some industry situations in which firm is operate, such as commodity versus non commodity and competitive versus non-competitive. Deshpande and Parley (1998a) study potential influences of industry characteristics on market orientation and business performance. They classify the industry into consumer goods (durables and nondurables), industrial goods (capital goods, raw materials, and others), and services (financial and others) and find that industry at this level of aggregation or classification has little or no effect on either performance or market orientation.

Seines, Jaworski and Kohli (1996-1997), Deshpande and Farley (1998a) examine the explanatory power of the regional market environment for both market orientation and performance, but the results consistently indicate that the geographic environmental factor plays no significant role.

Kohli and Jaworski (1990) propose that the degree of market orientation is influenced by the market environment (i.e., market turbulence, competitive intensity, and technological turbulence), and two factors (supply-side factors and demand-side factors) moderate the relationship between market orientation and business performance. However, Jaworski and Kohli (1993) find that none of the three environmental characteristics (i.e. market turbulence, technological turbulence, and competitive intensity) plays a moderating role. Jaworski and Kohli (1993) conclude that a market orientation probably is robust across various market contexts.

Slater and Narver (1994) also investigate the moderating role of competitive environment on the market orientation and performance relationship. The rationale for this hypothesized role is that effectiveness of a particular strategic orientation is contingent on market environment factors (Day and Wensley 1988; Hambrick 1983; Kohli and Jaworski 1990; McKee Varadarajan, and Pride, 1989; Snow and Hrebiniak, 1980). If, demand is growing faster than supply, a firm could simply cash in on the opportunity without being highly market oriented (Kohli and Jaworski 1990). Similarly, if the buyer's bargaining power is low, the seller firms could use this leverage to profit from the transaction with a minimal level of market orientation (Slater and Narver 1994). Conversely, if the market is characterized by intense seller competition, the seller firms could not achieve acceptable levels of profit without being market oriented (Day and Wensley 1988; Slater and Narver 1994).

Slater and Narver (1994), however, find only mixed support for the moderating effects hypotheses of environmental factors (i.e., market turbulence with return on assets, technological turbulence with new product success, and market growth on sales growth). Slater and Narver (1994) conclude that across different market environments, the positive relationship between market orientation and profitability is robust (Narver, Park, and Slater 1992; Narver and Slater 1991; Slater and Narver 1994).

Although prior studies find only limited support for the moderating roles by market environment, the findings direct us to a factor that is related to, but different from market environment (Greenley 1995). More specifically, the classic structure-conduct-performance paradigm (Thorelli 1977; Vernon 1972) suggests that the conduct of the firm is constrained by the internal and external structure (i.e. environments) of the firm and that its performance is a result of the response to such environments. The theoretical contention is that if the conduct is "right," enabling the organization to fit its environments better. It should lead to better performance. In reality, however, it is perceived environment that is a determinant of the response of the firm and it is business strategy that incorporates, articulates, and reflects on management's perceived environment. The firm then communicates and implements the direction and focus of the response, or business strategy by setting specific performance goals, criteria, and actions (Cbandler 1962).

Walker and Ruekert (1987) argue that strategic orientation, performance on particular dimensions, and marketing activities have contingent relationships.

Gatignon and Xuereb (1997) operationalized strategic orientation as a combination of customer, competitor and technological orientation. Their focal interest lies in the relative importance of the three orientations in marketing execution (especially on innovation). More broadly, a strategy type is a generic pattern of response at the business-unit level pertaining to the product-market domain, choice of performance criteria, and marketing execution. Thus, it is distinct from a market orientation that is purported to facilitate businesses' understanding of the market environment and is hypothesized to facilitate superior performance in the chosen, specific criteria set by the strategy type. Business strategy is a general direction of the firm's response based on the filtered or distilled environmental information. Therefore, it can conceivably explain the varying magnitude of relationship between performance measures and a firm's specific marketing response mechanism, such as a market orientation.

Kohli and Jaworski's (1990) conceptualization of a market orientation as an organized set of marketing activities, the degree to which market orientation is related to business performance could vary across different business strategies than the market environment that influences the business strategies (Hambrick 1982; Jemison 1984). Because implementing a strategy requires control and monitoring of its effectiveness in the market, a particular strategy pursued by an organization may determine the kinds of performance dimensions. it strives for and attends to and the level of performance relative to competition with other strategic orientations. Because Miles and Snow's (1978) typology posits strategic orientation as a planned pattern of organizational adaptation to the perceived environment (market), it is particularly relevant to a market orientation that refers to a firm's externally oriented intelligence-related activities and Snow (1978). It has been empirically demonstrated that the typology is a useful framework in distinguishing different strategic orientations of firms (Hambrick 1982, 1983; McDaniel and Kolari 1987; Snow and Hrebiniak 1980).

Organizations which operate in two types of product-market domains, one relatively stable, the other changing. In their stable areas, these organizations operate routinely and efficiently through formalized structures and processes. In their more turbulent areas, top managers watch their competitors closely for new ideas, and then they rapidly adopt those which appear to be the most promising. (Miles and Snow, 1978)

Miles and Snow (1978) contend that organizations delicately choose the appropriate strategy to fit themselves to their environment. Furthermore, organizations select their strategies on the basis of the environment, intending to the good at particular performance criteria, such as economic efficiency and new product innovation. Therefore, it can be hypothesized that the relationships between market orientation and some aspects of economic performance are not monotonic across organizations. Depending on the strategy type and its primary performance criteria, the relationships can be either strengthened or weakened. However, a direct influence of strategy type on the level of market orientation is less conceivable. Whatever strategy a firm choose, it may (or may not) engage in intelligence-related activities. For example, within the same strategy type, some defender companies may engage extensively in intelligence-related activities in search of cost reduction, but others may not. Some prospector companies may not actively engage in intelligence- related activities, perhaps, such activities can be too costly and time-consuming to bring out a new product quickly, but others may choose to engage in these activities in search of new, unnoticed market needs. Also across different strategy types, no prior theoretical reasons seem to predict whether a company with a certain strategy type is more (or less) likely to engage in intelligence-related activities (or market orientation). For example, a defender company may engage in a high level of market orientation in search of a low-cost supplier, a prospector company may engage in a high level of market orientation as well as in search of unexplored foreign markets, and an analyser company may engage in an equally high level to avoid falling too far behind prospectors. Companies with different strategies may well engage in high or low levels of market orientation. Thus, there seems to be no consistent and predictive pattern between strategy type and the level of market orientation. In spite of these suggestions that environment-based strategy choice moderate the market orientation-performance relationship (e.g. Day and Wensley 1988; Hurley and Huit, 1998; Kohli and Jaworski, 1990; Miles and Snow, 1978), it has been neither investigated nor understood well whether strategy type moderates the market orientation-performance relationship. Understanding such potential moderating effects is important for understanding the relationship between market orientation and economic performance.

Galbraith and Schendel (1983) found that the effectiveness of the overall business strategy depends substantially on how well activities in the various functional areas are integrated to form a pattern. Since, a market-oriented culture can positively influence the degree of focus and inter-functional coordination in the firm, strategy implementation may be improved leading to higher performance.

Peterson (1985) has indicated that industry structure and environmental dimensions significantly affect small firm performance. However, structure and environment ignore the internal capabilities of the firm to respond appropriately to the needs of customers and the actions of competitors.

Miles (1980) pointed out that the neglect of the boundary spanning functions for gathering timely and relevant environmental information is evident in the high failure rates of new businesses. This argument is reinforced by Dillinger's (1985) showed a positive relationship

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between use of environmental information and small firm performance.

Covin and Slevin (1989) found that performance in small firms in hostile environments was positively related to an organic structure, an entrepreneurial structure posture, a long-term orientation, high products prices and a concern for predicting industry trends. On the other hand, the research found that in benign environments, performance was positively related to a mechanistic structure and conservative strategies posture.

Pelham and Wilson's (1996) found during the study of small firm that the influence of firm strategy, firm structure, and the direct influence of the competitive environment had a lesser impact on the dimensions of performance than having a market-oriented culture.

Pelham (1999) conducted a study similar to Covin and Slavin's (1989) study to determine the extent of the environment's direct and indirect influences on small firm performance. This study utilized both subjective and objective measures of broad industry environment constructs (such as market turbulence and munificence). Pelham finds a positive explanation for the limited influences of the environment found in his study by suggesting that the small firm's simpler organizational structure. Pelham's (1999) study compared the impact on external constructs, this study provide small business managers more understandable guides to strategy emphasis and specific market-oriented activities as well as possible indicators of industry. This study also sought to describe the impact of specific industry variables and firm size on the relationships between relative strategy, market orientation and performance variables.

Pelham (2000) has found significant positive relation between market orientation and performance i.e. sales efficiency, growth to market share ratio and profitability from different small industries in USA. Homburg, Hoyer and fassnacht (2002) also conducted the same study at two separate geographic zones i.e. USA and Germany. They find a significant positive relation between market orientation and performance.

A market orientation is a reflection of a corporate state of mind (Felton, 1959). Particular business philosophy (Gronroos, 1989; McNamara, 1972; Webster, 1988). It is manifested as that type of organisational culture which engenders the behaviours necessary for creating superior customer value (Deshpande et al, 1993; Slater and Narver, 1995). Thus scholars concerned with the market orientation generally measure those attitudinal behavioural variables which are presumed to reflect this underlying culture. Not included in the analysis, however, those strategy and structure variables which may also have a bearing on the firm's performance (Pelham and Wilson, 1996). It is assumed by many scholars that market orientation ensure the market-based efficacy of the firm's strategy making activities and the effective implementation of those strategies.

Marketing orientation is perceived as a system of corporate beliefs and value pivoting around; (1) the creation of superior customer value at a profit while not neglecting the interest of other key stakeholders, (2) the shaping of the company's internal environment and climate so that the company can be responsive to market information (Forker, 1997).

It can be inferred that marketing orientation is an organised culture that places the customer in the centre of the strategies or even at the top of the company's considerations. Hult (1999a) admits this culture dimension when finding that the company's top management believes have a catalytic role as to whether the firm pursues a market orientation or not.

Quality of the products has become an important aspect of competitiveness and key market access concern in the export markets (Burke and Jarhatt, 2004). Customers are increasingly demanding International standards orientation (ISO) certificate, since they act as signals for quality, health and safety, and environment best practices (GoK 2007). Value creation for customers calls for close co-ordination between marketing and quality departments (Slater and Narver, 1995). Both quality implementation and market orientation require an organisational structure to be designed around the flow of value-adding activities and should also empower employees to manage organisational change. Given the information oriented nature of quality practices and market oriented firm, quality implementation may offer a rich array of tools that organisations could be transformed in achieving market orientation.

Kohli and Jaworski (1990) reasoned that the term "market orientation" inferred the implementation of the well-known marketing concept being one type of business philosophy. It is the translation of this philosophy into practice that engenders a market orientation.

Kohli and Jaworski (1990) defined market orientation as the organisation –wide generation of market intelligence, dissemination of the intelligence across departments and organisation wide responsiveness to it.

Kohli and Jaworski (1990) recognised a difference between the 'received view' and their own field-based view of market orientation. The received view is based on three commonly accepted components; (1) a customer focus, (2) coordinated marketing and (3) profitability objectives.

According to Kohli, Jaworski and Kumar (1993) defined market orientation refers to the organisation wide generation of market intelligence pertaining to current and future needs of the customers, dissemination of intelligence within the organisation and responsiveness to it.

Key features of this integrated view are

- 1. An expended focus on market rather than customer intelligence
- 2. An emphasis on a specific form on inter-functional coordination with respect to market intelligence.
- 3. A focus on activities related to intelligence processing rather than the effect of these activities.

The marketing concept holds a significance role in organisation success. It helps to find determination and satisfaction of the needs, wants and aspirations of target market. It must be pursued more effectively and efficiently as compare to competitors and with the intension of achieving profitability and satisfying objectives. In other words, the marketing concepts state that if a business is to achieve profitability and satisfy its objectives, the entire organisation must be oriented towards satisfying customer needs, wants and aspirations.

In the sense, market orientation derives from the application of the marketing concept.

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Market orientation emphasizes competitiveness and profit based on identifying consumer needs, wants and aspiration and delivering compatible offerings which are competitively better than competitors.

A market orientation firm is one which successfully applies the marketing concept. (Kohli and Jaworski, 1990; Pitt et al, 1996; Caruanna et al, 1999).

Market orientation of the firms has developed as an operationalisation of the marketing concept. A recent definition of market orientation as "the set of cross-functional processes and activities directed at creating and satisfying customer through continuous need assessment" (Despande and Farley, 1998) established a general pattern between market orientation and various measures of business performance.

As with the market orientation, the focal points in the relationship marketing literature is satisfying customers need. Kalwani and Narayandas (1995) provide the basis for a connection between the two constructs with their definition of the marketing concept as emphasizing the needs and wants of the customers and satisfying these needs more efficiently than the competitor while looking at customer relation from a long-term perspective.

According to Dalgic (1990) marketing orientation express a marketing perception which put the customer's needs in the centre of all firm's activities.

Despande & Farley, (1998); define the market orientation as the set of cross-functional processes and activities directed at creating and satisfying customers through continuous needs assessment.

Kohli and Jaworski offered an alternative operationalisation based on (1) intelligence gathering, (2) intelligence dissemination and (3) responsiveness.

Narver and Slater (1990) define market orientation as the "organisation culture that most effectively creates the necessary behaviours for the creation of superior value for buyers and thus superior performance for the business".

Narver and Slater (1990) defined a measure of market orientation based on the organisational behaviours of customer orientation, competitor orientation and inter functional coordination. They found a significant relationship between market orientation and return on investment (ROI).

Berry and Parasuraman (1991) also focus on customers; "Relationship marketing concerns attracting, developing and retaining customer relationships". This is particularly true for business-to business marketing in which buyers and sellers tend to be in continuous, direct contract with one another at personal as well as organisational levels.

According to Narver & Slater (1990-91) market orientation is a business culture in which all employees are committed to the continuous creation of superior value for the customers.

Market orientation is the business culture that produces outstanding performance through its commitment to creating superior value for customers.

The value and belief implicit in this culture encourage.

- 1. Continuous cross-functional learning about customers expressed and latent needs and about competitors' capabilities and strategies.
- 2. Cross-functionally coordinated action to create and exploit the learning. (Shapiro, 1998; Despande and Webster, 1989; Day, 1990, 1994a; Kohli and Jaworski, 1990; Narver and Slater, 1990; Slater and Narver, 1995). In the first rigorous study of the effect of a market orientation on business performance.

In contrast with Kohli and Jaworski (1990), Narver and Slater's (1990) operationalisation of market orientation stayed closer to mainstream view by incorporating three behavioural components; customer orientation, competitor orientation and interfunctional coordination.

These variables were defined as follows;

- Customer orientation; the sufficient understanding of target buyers so as to be able to create superior value for them continuously.
- Competitor orientation; understanding the short-term strengths and weaknesses and the long term capabilities of both current and potential competitors
- Inter-functional coordination; the coordinated utilization of company resources for creating superior value for target customers.

In the research, Dang and Dart (1994) tried to mix the views of Kohli and Jawarski (1990) and Narver and Slater (1990) that in their research, market orientation was treated the market orientation as implementing the trade and business philosophy like the marketing concept.

It is observed that market orientation is an operational extension of market philosophy. Day (1994) notes that to achieve the marketing capabilities should be implemented and executed in organization better than ever. These capabilities should be able to cover the following aspects, feeling the market opportunities, communication with service, seeking the technology and try to use it, developing the products and presenting the new versions and new services, human and financial source management, organizational communications and establishing the general and integrated strategy in organization.

According to Navdeep Agrawal, market orientation has been of interest to both researchers and practitioners for several years. However, the major focus of research and discussions has been the market orientation- performance relationship. Despite having been pointed out by some authors, the development of insights to the factors that impede the development of market orientation have remained largely ignored- more so in developing economies and emerging markets like India.

According to Sanjay Kumar Jain and Manju Bhatia (2007), Market orientation has come to be recognized as a key concept in marketing literature. Researches in other countries point to the presence of a positive relationship between market orientation and business performance. In the Indian context, however, little evidence exists to demonstrate that market orientation is an activity worth pursuing by the business firms. Based on an empirical investigation, the research shows a strong relationship between market orientation and various financial and non-financial measures of business performance among manufacturing firms in India.

The final investigation of these two views leads to this matter that the long-term value for the customers finally results in the firms benefit. This issue forms the marketing basic philosophy and is the main motivation for market oriented firm. (Sheppard, 2011)

# CONCLUSION

Market orientation appears to provide a focus for efforts of individuals and departments of an organization in order to build superior value to customer, leading to superior performance. A market oriented organisation monitors continuously customer's need and attempts to satisfy them by modifying the organisational offering whilst remaining profitable (Kohli & Jawarski, 1990; Nervar & Slater, 1990). Moreover, the organization is in a position of understanding customer's needs. This results in closing potential gap between the management of the organization and its customers and leads to better firm performance. (Pelham and Wilson, 1996)

Until the last decade, the linkage between market orientation and performance appeared to have been taken for granted by both academies (McGee and Spiro, 1988; Webster, 1988) and practitioners (Kohli & Jawarski, 1990)

Jawarski and Kohli (1993) found that market orientation is positively related to overall firm performance. It is widely known that a number of studies having as a starting point the studies of the above mentioned scholars were undertake in order to test the relationship between market orientation and organisational performance.

Despande *et al.* (1993) empirically investigated this relationship in Japan. It has been found that the association between market orientation and sales, profit-ability, ROA and overall performance is significant in German context.

Fritz, 1996), Pitt *et al.* (1996) conducted a study in U.K. and Malta and found that the level of market orientation positively affect financial performance i.e. ROCE and sales growth.

Soehadi et al (2001) found that market orientation positively affects retail business performance in an Indonesian context. It is widely known that the service sector has a closer relationship with the customer and this fact forces service provides to be more market oriented and more flexible in order to respond to market needs.

According to Rodney Oudan (2012), the role of market orientation on trade and firm performance is very effective. Recent studies conducted in the United States and Europe have shown significant evidence of the relationship between market orientation and business performance. Kohli and Jaworski's empirical work has provided the critical first steps in the examination of market orientation theory. The aim of the research was to build on this limited body of literature and provide a conceptual model. Market orientation focuses on a business culture producing superior value to customers and outstanding performance for the firm leading to growth and benefits for trade. The findings of the research suggest market orientation is positively related to business performance. Secondly, firm performance can dramatically improve output which can result in expanded markets and trade.

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# IMPACT OF TECHNICAL AIDS IN TEACHING ON ACHIEVEMENT OF B. ED STUDENTS

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#### ABSTRACT

This paper discuss the impact of teaching with technical aids (PowerPoint Presentation and Computer Assisted Instruction) on achievement of B. Ed students. A validated achievement test comprising of 50- item multiple choice test was developed by researcher. Split-half reliability was computed for the test. Results revealed that main effect of teaching method on academic achievement was highly significant. It means students taught with technological aids perform better than those taught by the traditional method. On the other hand, students of different SES were not equally benefitted. However, students of different locality & gender benefits equally.

Keywords: Achievement, Computer Assisted Instruction, Power point Presentation, Technological aids.

## INTRODUCTION

The concept of teaching was determined by the philosophers and teachers of ancient time. During those days teaching was dominated by teachers but gradually changes in teaching were found because of successive researches. Teaching was mostly decided by the ways teacher himself was taught the subject. The approach worked satisfactorily because the quantum of knowledge available in the field was limited and students passing these courses were highly motivated. Now the situation has changed as the horizon of knowledge in a particular subject has widened to unexpected largeness, it has become very difficult to communicate even narrow specialized fields to coming generations. Hence very rigorous approaches to teaching are to be selected. They cannot be taught by any method selected by the teacher, for them more scientific and research based effective methods are to be employed for successful communication of selected disciplines in a limited time with its inflated magnitudes. The secret of effective teaching does not lie in possessing piled up

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brilliant academic record but knowing the learner, i.e. a deep insight of learner's intelligence, grasping ability, draw-backs and inhibitions.

# **Teaching with Technology**

Teaching is becoming one of the most challenging professions in our society where knowledge is expanding rapidly and much of it is available to students as well as teachers at the same time (Perraton, Robinson and Creed, 2001). As new concepts of learning have evolved, teachers are expected to facilitate learning and make it meaningful to individual learners rather than just to provide knowledge and skills. Recent developments of innovative technologies have provided new possibilities to teaching profession but at the same time have placed more demands on teachers to learn how to use these technologies in their teaching. (Robinson and Latchem, 2003).

Globally, educational systems are under great pressure to adopt innovative methodologies and to integrate new Information and Communication Technologies(ICT) in the teaching and learning process, to prepare students with the knowledge and skills they need in the 21<sup>st</sup> century. Apparently, teaching profession is evolving from an emphasis on teacher-centered, lecturebased instructions to student-centered interactive learning environments. New Information and Communication Technologies integration is understood as the usage of technology seamlessly for educational processes like transacting curricular content, students working on technology to do authentic tasks and developing technology supported products, providing authentic assessments and institutional development.

Today a variety of technologies can facilitate not only delivery of instruction but also learning process itself. There is a range of options of latest technologies - from Video conferencing through multimedia delivery to websites which can be used to meet the challenges teachers face today. The educational system needs to come to terms with these new challenges and take full advantage of the opportunities. Therefore, the challenge for higher education institutions, particularly teacher education, has been to create a new generation of teachers capable of employing a variety of technology tools into all phases of academic, administrative, research, and extension functions.

## Use of Computers in Teaching

Technology can help facilitate the knowledge-constructed classroom. A number of researchers (Bork, 1985; Laboratory for Comparative Human Cognition, 1989; Papert, 1980; Ragosta, 1983) found computers having influential effect on the teaching and learning processes. Their general finding is that with the use of computers in the classroom, schools would become more student-centered and that more individualized learning would take place than ever before.

## **Overview of Presentation Software**

Presentation software, such as PowerPoint 2000, automates the process of creating overhead transparencies by allowing the user to create visuals no longer by hand, but instead to develop professional-quality graphics that can incorporate clip art, digital images, and even video and animation. There are currently four presentation software packages available to consumers-

PowerPoint 2000 for the PC (PowerPoint 2001 for the Macintosh), Corel Presentations 9.0, Harvard Graphics 98, and Astound 7.0.

In November 1998, *Presentations* magazine, a trade publication targeted for professional speakers and trainers, surveyed 300 of its subscribers. 94% of respondents used PowerPoint to support their oral presentations at least part of the time. Corel Presentations ranked as the second most popular application ("Power-Point," 1998). Due to the popularity of PowerPoint, the term "PowerPoint" is used to refer to all presentation software packages. Recent employer surveys suggest that universities need to be teaching students how to use the software (Chalupa, 1997; Davis, 1997; Griffin,1995; North & Worth, 1997; U.S. Department of Labor, 1992).

## **Power Point and Lectures**

Power Point allows a lecturer to take advantage of the educational benefits of using visual aids and technology in lectures in order to improve the effectiveness of teaching and learning. Teaching with Power Point does not necessarily involve radical changes to teaching approaches, though it can if the lecturer so wishes. Even as a tool to create better designed black and white or colour transparencies, the default settings of the Power Point software require a lecturer to abide by, or at least consider, basic principles of instructional design in the point sizes of text, bullet points, framing and layout of slides (Jackson SF, 1997). The results of the student survey suggest that lecturers should take particular care in designing their PowerPoint presentations and to ensure that they are not so overfeatured as to become distracting.

## Use of CAI in Lecture

The revolution of CAI shows that CAI has existed for more than fifty years. The first CAI was designed at the Massachusetts Institute of Technology in 1950 (Hockard, Alarms and many 1997). In 1970 an important development occurred in CAI, The National Science Foundation provided \$ 10 million funding For PLATO (Programmed Logic for Automatic Teaching) and TICCIT (Time Saved Interactive Computer Controlled Information Television System). Computer- assisted instruction has been used for more than five decades for educational purposes.

## STATEMENT OF THE PROBLEM

In the view of the preceding discussion, the problem proposed here for the paper is

## "Impact of technological aids in teaching on achievement among B. Ed students."

## **OPERATIONAL DEFINITIONS**

**Technology:** Technology is the making, usage and knowledge of tools techniques, craft, systems or methods of organization in order to solve a problem or serve some purpose.

**PowerPoint Presentation:** Microsoft PowerPoint is a popular software tool used to create graphical electronic presentations. Presentations are comprised of slides containing text, audio, video, and other graphics.

Computer Assisted Instruction: Computer assisted instruction is the process by which

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written and visual information is presented in a logical sequence to a learner through computer .The student learns by reading the text material presented or by observing the graphics information displayed.

Achievement: Achievement is the learning outcome of the students. It is the competence of students shown in subject for which they have been given instructions

**B. ED. Students:** The students who are enrolled in the regular course of Bachelor of Education (B. Ed program.)

# **OBJECTIVES OF THE STUDY**

In view of the above mentioned considerations, the present investigation will be carried out to realize the following major objectives:

- 1. To find out the main effect of group on achievement of B. Ed. Students.
- 2. To find out the main effect of gender on achievement of B. Ed. Students.
- 3. To find out the main effect of locality on achievement of B. Ed. Students.
- 4. To find out the main effect of SES on achievement of B. Ed. Students.

To find out interaction effect of group, gender, SES, and locality on achievement of B. Ed. Students.

# HYPOTHESIS

Keeping in view the objectives of study, the following null hypotheses will be formulated for the proposed study-

 $1.H_1$ : Significant main effect of group (Teaching Method) does not exist on the achievement of B. Ed. Students.

2.H.: Main effect of gender on the achievement of B. Ed. students is not significant.

3.H<sub>3</sub>: Main effect of locality on the achievement of B. Ed. students is insignificant.

 $4.H_4$ : Insignificant main effect of Socio Economic Status exists on the achievement of B. Ed. students.

 $5.H_5$ : Significant interaction effect among group (Teaching Method), gender, locality, and SES does not exist in relation to the achievement of B .Ed students.

# Methodology

The present investigation was a quasi-experimental research, which uses two-group pretest-post test design. Analysis of covariance (ANCOVA) was used in the present study to find results.

# **Population and Sample**

To draw out the sample purposive sampling technique was used. Two B .Ed colleges 1.Adharshila college of education 2.Dewan college of education were selected for the study. One intact section served as the experimental group and the other as the control group.

# VARIABLES UNDER THE STUDY

The following types of variables were considered/affecting the study:

## **Independent Variables**

The teaching method served as the independent variable for the study.

## **Dependent Variables**

Academic achievement was chosen as dependent variable.

## **Control Variables**

Length of instruction was controlled as each teaching session in each section (group) lasted for one college period of 45 minutes.

## Confounding (Intervening and extraneous) Variables

In order to neutralize the effect of these and other confounding variables, analysis of covariance (ANCOVA) was used in the present study. Some other confounding variables such as anxiety, fatigue, motivation, age, enthusiasm, and academic ability etc. were thought to be neutralized by the selection of similar intact classe

## **Tools Used**

Achievement Test (developed by the researcher) was used to carry out the present study.

## **Achievement Test**

Achievement Test was developed and validated by the researcher. The final form of Achievement Test thus consisted of 50 items out of which knowledge, understanding and application-level items were respectively 40% (N=20), 40%(N=20), and 20%(N=10).

# **Reliability of AT**

Split-half reliability was computed for the test. The correlation (product-moment) between two halves was calculated with the formula. The correlation coefficient between the two halves  $(r^{1}/2.1/2)$  came out to be 0.58 and, therefore, the reliability coefficient for the whole test was calculated to be 0.89. It has been stated by many experts that test reliability in excess of 0.50 is satisfactory for a group test (e.g., Harris, 1968, Singh, 1997). Thus, it may be concluded that AT is a reliable test.

# Validity of Achievement Test:

In the present study, for the Achievement Test content validity was established. As the internal consistency reliability computed for the test was high (0.73), it further establishes that Achievement Test has adequate content validity. Data relating to the discriminating power of the selected items also provided circumstantial evidence for the content validity.

# **Results related with Academic Achievement**

The data related to academic achievement of sample B. Ed. students was analyzed keeping in mind the above objectives. Table 1 presents the yielded descriptive statistics related to academic achievement of B. Ed. students.

Table 1: Descriptive Statistics							
			Dependent Var	riable: Achi	evement	Post	
SES	Gender	Locality	Group	Mean	Std. Deviation	Ν	
Below1	Male	Urban	Control	27.25	6.397	4	
Lac			Experimental	35.00	•	1	
			Total	28.80	6.535	5	
		Rural	Control	29.50	4.747	16	
			Experimental	36.36	3.501	11	
			Total	32.30	5.434	27	
		Total	Control	29.05	5.010	20	
			Experimental	36.25	3.361	12	
			Total	31.75	5.651	32	
	Female	Urban	Control	30.50	7.853	4	
			Experimental	32.00	•	1	
			Total	30.80	6.834	5	
		Rural	Control	33.00	3.688	6	
			Experimental	35.82	4.119	11	
			Total	34.82	4.096	17	
		Total	Control	32.00	5.457	10	
			Experimental	35.50	4.079	12	
			Total	33.91	4.966	22	
	Total	Urban	Control	28.88	6.854	8	
			Experimental	33.50	2.121	2	
			Total	29.80	6.391	10	
		Rural	Control	30.45	4.677	22	
			Experimental	36.09	3.741	22	
			Total	33.27	5.064	44	
		Total	Control	30.03	5.262	30	
			Experimental	35.87	3.675	24	
			Total	32.63	5.440	54	

Between1	Male	Urban	Control	29.58	4.274	12
to 3 Lac			Experimental	35.22	2.728	9
			Total	32.00	4.604	21
		Rural	Control	27.85	4.413	13
			Experimental	35.43	3.936	14
			Total	31.78	5.625	27
		Total	Control	28.68	4.347	25
					Total	23
			Female	Urban	Control	48
				28.50	4.359	12
			Experimental	33.36	4.225	11
			Total	30.83	4.877	23
		Rural	Control	27.33	5.785	6
			Experimental	34.86	5.786	7
			Total	31.38	6.777	13
		Total	Control	28.11	4.739	18
			Experimental	33.94	4.783	18
			Total	31.03	5.547	36
	Total	Urban	Control	29.04	4.258	24
			Experimental	34.20	3.665	20
			Total	31.39	4.731	44
		Rural	Control	27.68	4.726	19
			Experimental	35.24	4.493	21
			Total	31.65	5.938	40
		Total	Control	28.44	4.468	43
			Experimental	34.73	4.093	41
			Total	31.51	5.309	84
Between 3	Male	Urban	Control	36.50	2.121	2
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to 6 Lac			Experimental	42.00	3.606	3
			Total	39.80	4.087	5
		Rural	Control	32.00	9.899	2
			Experimental	33.33	4.163	3
			Total	32.80	5.805	5
		Total	Control	34.25	6.397	4
			Experimental	37.67	5.888	6
			Total	36.30	6.001	10
	Female	Urban	Control	32.80	6.303	10
			Experimental	36.09	3.562	11
			Total	34.52	5.202	21
		Rural Total	Control	28.00	4.203	7
			Experimental	36.20	2.588	5
			Total	31.42	5.468	12
			Control	30.82	5.908	17
			Experimental	36.13	3.202	16
			Total	33.39	5.431	33
	Total	Urban	Control	33.42	5.915	12
			Experimental	37.36	4.254	14
			Total	35.54	5.368	26
		Rural	Control	28.89	5.349	9
			Experimental	35.13	3.314	8
			Total	31.82	5.423	17
		Total	Control	31.48	5.997	21
			Experimental	36.55	4.009	22
			Total	34.07	5.633	43

Above 6	Male	Urban	Control	31.00	•	1
Lac			Experimental	33.50	2.121	2
			Total	32.67	2.082	3
		Rural	Experimental	45.00		1
			Total	45.00		1
		Total	Control	31.00		1
			Experimental	37.33	6.807	3
			Total	35.75	6.397	4
	Female	Urban	Control	34.00	4.183	5
			Experimental	38.38	5.397	8
			Total	36.69	5.266	13
		Rural Total	Experimental	36.00	2.828	2
			Total	36.00	2.828	2
			Control	34.00	4.183	5
			Experimental	37.90	4.954	10
			Total	36.60	4.940	15
	Total	Urban	Control	33.50	3.937	6
			Experimental	37.40	5.232	10
			Total	35.94	5.039	16
		Rural	Experimental	39.00	5.568	3
			Total	39.00	5.568	3
		Total	Control	33.50	3.937	6
			Experimental	37.77	5.118	13
			Total	36.42	5.092	19

Total	Male	Urban	Control	29.89	4.977	19
			Experimental	36.33	3.922	15
			Total	32.74	5.528	34
		Rural	Control	28.97	4.861	31
			Experimental	35.90	4.083	29
			Total	32.32	5.667	60
		Total	Control	29.32	4.876	50
			Experimental	36.05	3.988	44
			Total	32.47	5.591	94
	Female	Urban	Control	31.03	5.701	31
			Experimental	35.58	4.624	31
			Total	33.31	5.635	62
		Rural	Control	29.37	5.047	19
			Experimental	35.64	4.142	25
			Total	32.93	5.487	44
			Control	30.40	5.470	50
			Experimental	35.61	4.376	56
			Total	33.15	5.551	106
	Total	Urban	Control	30.60	5.414	50
			Experimental	35.83	4.378	46
			Total	33.10	5.575	96
		Rural	Control	29.12	4.885	50
			Experimental	35.78	4.073	54
			Total	32.58	5.573	104
		Total	Control	29.86	5.184	100
			Experimental	35.80	4.195	100
			Total	32.83	5.567	200

ANCOVA was applied to find out the main effect and interaction effect of group (teaching method) and gender. The result obtained has been presented in Table 2 as below.

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	Hypothesis	7143.061	1	7143.061	71.923	.046
	Error	125.097	1.260	99.316ª		
Achieve-	Hypothesis	2075.089	1	2075.089	176.464	.000
ment_Pre	Error	2293.057	195	11.759 <sup>b</sup>		
Gender	Hypothesis	2.548	1	2.548	20.089	.302(n.s.)
	Error	.063	.500	.127°		
Group	Hypothesis	1116.298	1	1116.298	2774.941	.000**
	Error	2.106	5.236	.402 <sup>d</sup>		
Gender *	Hypothesis	.179	1	.179	.015	.902(n.s.)
Group	Error	2293.057	195	11.759 <sup>b</sup>		

Table 2 : ANCOVA for Group & Gender w.r.t. Academic Achievement

\*\* significant at 0.01 level of significance.

\* significant at 0.05 level of significance.

n. s. stands for not significant.

H<sub>1</sub>: Significant main effect of group does not exist on the achievement of B. Ed. Students.

H2; Significance main effect of gender does not exist on the achievement of B.Ed students.

A perusal of Table 2 makes it clear that main effect of group (teaching method) on academic achievement of B. Ed. students is found to be highly significant (F=2774.941; p<0.01). The means for the two groups are shown in Table 3 below:

Table 3: Descriptive Statistics with respect to Gender							
Dependent Variable: Achievement_ Post							
Gender	Group	Mean	Std. Deviation	Ν			
Male	Control	29.32	4.876	50			
	Experimental	36.05	3.988	44			
	Total	32.47	5.591	94			
Female	Control	30.40	5.470	50			
	Experimental	35.61	4.376	56			
	Total	33.15	5.551	106			
Total	Control	29.86	5.184	100			
	Experimental	35.80	4.195	100			
	Total	32.83	5.567	200			

Table 3 shows that mean academic achievement for the control group was 29.86 and that for experimental group was 35.80. It means that B. Ed. students of experimental group achieved significantly higher than their control group counterparts. It infers that teaching through technological aids significantly increases academic achievement of B. Ed. students. Hence, the first null hypothesis  $H_1$  which states that "Significant main effect of group (Teaching Method) does not exist on the achievement of B. Ed. Students" is rejected.

Table 2 also reveals that main effect of gender on academic achievement of B. Ed. students was not significant (F=20.089; n.s.). It means that male and female B. Ed. students do not differ significantly with respect to their academic achievement. Thus, the second null hypothesis  $H_2$  which claims that "Main effect of gender on the achievement of B. Ed. students is not significant" is accepted.

It is further clear from Table 2 that interaction effect of group and gender in relation to academic achievement of B. Ed. students was also found to be insignificant (F=0.015; n. s.). It means that both male and female B. Ed. Students benefit equally from technological aids.

This can also be clarified from the graph shown in Fig-1 & Fig-2 below, that the the experimental group performed much better in comparison to the control group. That means the use of technological aids is beneficial to the B.Ed. students although this difference is not significant for gender this shows that both male and female benefited equally.





Figure 1 : Academic Achievement with respect to Gender

<b>Table 4: ANCOVA for Grou</b>	p & Localit	y with respect to	Academic A	Achievement
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Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	Hypothesis	7261.137	1	7261.137	73.078	.046
	Error	124.923	1.257	99.362ª		
Achievement	Hypothesis	2069.250	1	2069.250	177.133	.000
(Pre)	Error	2277.972	195	11.682 <sup>b</sup>		
Locality	Hypothesis	2.750	1	2.750	.183	.742(n.s.)
	Error	15.171	1.009	15.029°		
Group	Hypothesis	1110.683	1	1110.683	74.301	.067(n.s.)
	Error	15.677	1.049	14.948 <sup>d</sup>		
Locality *	Hypothesis	15.050	1	15.050	1.288	.258(n.s.)
Group	Error	2277.972	195	11.682 <sup>b</sup>		

H<sub>3</sub>: Main effect of locality on the achievement of B. Ed. students is insignificant.

A perusal of table 4 makes it clear that main effect of locality on academic achievement of B. Ed. students is found to be insignificant (F=0.183; ; ns). The means for the two groups are shown in table 4.05 below:

Dependent Variable: Achievement _ Post							
Locality	Group	Mean	Std. Deviation	Ν			
Urban	Control	30.60	5.414	50			
	Experimental	35.83	4.378	46			
	Total	33.10	5.575	96			
Rural	Control	29.12	4.885	50			
	Experimental	35.78	4.073	54			
	Total	32.58	5.573	104			
Total	Control	29.86	5.184	100			
	Experimental	35.80	4.195	100			
	Total	32.83	5.567	200			

Table 5 Descriptive Statistics with respect to locality

Table 5 also reveals that main effect of locality on academic achievement of B. Ed. students was not significant (F=0.183; n.s.). It means that male and female B. Ed. students do not differ significantly with respect to their academic achievement. Thus, the third null hypothesis **H3** which claims that "Main effect of locality on the achievement of B. Ed. students is insignificant." is accepted.

It is further clear from Table 4 that interaction effect of locality & group in relation to academic achievement of B. Ed. students was also found to be insignificant (F=1.288; n. s.). It means that both rural and urban B. Ed. students benefit equally from technological aids.

This can also be clarified from the graph shown in Fig-3 below, that the shows that both rural and urban B.Ed. students benefited equally.



Figure 2 : Academic Achievement with respect to Locality

Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
Intercept	Hypothesis	6833.755	1	6833.755	76.713	.043
	Error	113.455	1.274	89.082ª		
Achievement_	Hypothesis	1919.000	1	1919.000	170.340	.000
(Pre)	Error	2151.745	191	11.266 <sup>b</sup>		
SES	Hypothesis	113.370	3	37.790	13.600	.024 *
	Error	9.200	3.311	2.779°		
Group	Hypothesis	796.895	1	796.895	170.889	.000 **
	Error	70.085	15.029	4.663 <sup>d</sup>		
SES * Group	Hypothesis	8.030	3	2.677	.238	.870( <b>n.s.</b> )
	Error	2151.745	191	11.266 <sup>b</sup>		

Table 6: ANCOVA for Group & SES w.r.t. Academic Achievement

 $H_4$ : Insignificant main effect of Socio Economic Status exists on the achievement of B. Ed. students.

A perusal of Table 6 makes it clear that main effect of SES (teaching method) on academic achievement of B. Ed. students is found to be highly significant (F=13.600; p<0.05). The means for the two groups are shown in table 7 below:

Table 7 Descriptive Statistics with respct to SES

Dependent Variable: Achievement_Post							
SES	Group	Mean	Std. Deviation	Ν			
Below 1Lac	Control	30.03	5.262	30			
	Experimental	35.87	3.675	24			
	Total	32.63	5.440	54			
Between 1to 3 Lac	Control	28.44	4.468	43			
	Experimental	34.73	4.093	41			
	Total	31.51	5.309	84			
Between 3 to 6	Control	31.48	5.997	21			
Lac	Experimental	36.55	4.009	22			
	Total	34.07	5.633	43			
Above 6 Lac	Control	33.50	3.937	6			
	Experimental	37.77	5.118	13			
	Total	36.42	5.092	19			
Total	Control	29.86	5.184	100			
	Experimental	35.80	4.195	100			
	Total	32.83	5.567	200			

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Table 7 also reveals that main effect of SES on academic achievement of B. Ed. students was significant (F=13.600; p<=.05). It means that B. Ed. students of different socioeconomic status differ significantly exists on the achievement of B. Ed. students" is accepted.

It is further clear from Table 6 that interaction effect of SES and group in relation to academic achievement of B.Ed. students was also found insignificant (F=0.238;p>.05). It means that B. Ed. students of different socio economic status with different teaching methods benefit equally from technological aids.

This can also be clarified from the graph shown in Fig-4 below, that the the experimental group performed much better in comparison to the control group. That means by the use of technological aids the B.Ed. students of different socio-economic groups performed better by the use of technological aids.



Figure 3 : Academic Achievement with respect to SES

Dependent Variable: Achievement_Post							
Source		Type III Sum	df	Mean	F	Sig.	
		of Squares		Square			
Intercept	Hypothesis	5854.275	1	5854.275	83.284	.035	
	Error	95.768	1.362	70.293ª			
Achievement_	Hypothesis	1590.162	1	1590.162	138.958	.000	
(Pre)	Error	1933.950	169	11.443 <sup>ь</sup>			
Gender *	Hypothesis	12.751	1	12.751	.405	.633( <b>n.s.</b> )	
Locality	Error	33.660	1.070	31.457 <sup>g</sup>			
Gender * SES	Hypothesis	8.115	3	2.705	.163	.915( <b>n.s.</b> )	
	Error	50.254	3.035	16.556 <sup>h</sup>			
Gender *	Hypothesis	9.490	1	9.490	.249	.693( <b>n.s.</b> )	
Group	Error	46.286	1.214	38.120 <sup>i</sup>			
Locality * SES	Hypothesis	8.979	3	2.993	.218	.878( <b>n.s.</b> )	
	Error	37.926	2.762	13.731 <sup>j</sup>			
Locality *	Hypothesis	.300	1	.300	.008	.942( <b>n.s.</b> )	
Group	Error	39.093	1.074	36.406 <sup>k</sup>			
SES * Group	Hypothesis	20.752	3	6.917	.354	.797( <b>n.s.</b> )	
	Error	35.535	1.817	19.555 <sup>1</sup>			
Gender *	Hypothesis	20.659	3	6.886	.634	.642( <b>n.s.</b> )	
Locality * SES	Error	31.713	2.921	10.857 <sup>m</sup>			
Gender *	Hypothesis	33.288	1	33.288	3.080	.197( <b>n.s.</b> )	
Locality *	Error	26.778	2.477	10.809 <sup>n</sup>			
Group							
Gender * SES	Hypothesis	49.657	3	16.552	1.528	.382( <b>n.s.</b> )	
* Group	Error	28.807	2.660	10.830°			
Locality * SES	Hypothesis	28.459	2	14.230	1.324	.430( <b>n.s.</b> )	
* Group	Error	21.602	2.011	10.744 <sup>p</sup>			
Gender *	Hypothesis	21.484	2	10.742	.939	.393( <b>n.s.</b> )	
Locality * SES	Error	1933.950	169	11.443 <sup>b</sup>			
* Group							

# Table 8: ANCOVA for interaction effect among Group (Teaching Method), Gender, Locality & SES to Achievement

 $H_5$ : Significant interaction effect among group (Teaching Method), gender, locality, and SES does not exist in relation to the achievement of B .Ed students.

A perusal of Table 8 makes it clear that interaction effect among group (Teaching Method), gender, locality, and SES on academic achievement of B. Ed. students is found to be insignificant as the f-values for all the combinations are very low. It shows that there exit no significant effect among these four. Thus the fifth null hypothesis  $H_5$  which claims that "Significant interaction effect among group (Teaching Method), gender, locality, and SES does not exist in relation to the achievement of B. Ed students." is accepted. It means that both male and female B. Ed. students of different socio economic status, belonging to rural and urban areas using different teaching methods benefit equally from technological aids.

#### CONCLUSIONS

The following conclusions can be drawn from present investigation:

- 1. The main effect of group (teaching method) on academic achievement of B. Ed. students is found to be highly significant (F=2774.941; p<0.01). It infers that teaching through technological aids significantly increases academic achievement of B. Ed. Students.
- 2. The main effect of gender on academic achievement of B. Ed. students was not significant (F=20.089; n.s.). It means that male and female B. Ed. students do not differ significantly with respect to their academic achievement.
- 3. The main effect of locality on academic achievement of B. Ed. students is found to be insignificant (F=0.183; ns). It means that male and female B. Ed. students do not differ significantly with respect to their academic achievement.
- 4. The main effect of SES on academic achievement of B. Ed. students was significant (F=13.600; p<=.05). It means that B. Ed. students of different socioeconomic status differ significantly exists on the achievement of B. Ed. students" is accepted. It infers that both male and female B. Ed. students of different socio economic status, belonging to rural and urban areas using different teaching methods do not benefit equally from technological aids.
- 5. The interaction effect among group (Teaching Method), gender, locality, and SES on academic achievement of B. Ed students is found to be insignificant as the f values for all the combinations are very low. It shows that there exists no significant effect among these four. It means that both male and female B. Ed students of different socio economic status, belonging to rural and urban areas using different teaching methods benefit equally from technological aids.

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## **BOOK REVIEW**

#### *Review by Annavajhula J.C. Bose\**

### WHAT WE TALK ABOUT WHEN WE TALK ABOUT RAPE AUTHOR: SOHAILA ABDULALI Publisher: Penguin/Viking, 2018, Pp.229 Price: 300 INR. Hardcover

Sexual offence is perhaps the most bitter social truth now. It has become a global topic thanks to the Me-Too-Moments shared on social media leading to the so-called Me-Too-Movement to bring to limelight sexual predation as a global blot on our collective humanity. As I got exposed to this through my reading in newspapers in the last six months, and as I am a father of two girls, I began to wonder why individuals engage in sexually abusive behavior in the first place.

I started reading the numerous etiological and explanatory theories in relation to this as brought to our notice from the Center for Sex Offender Management in the USA. But this very immediately caused me a brain fade, or a concussion of my brain, so to say. There are many single factor theories of sexual offending behavior. And there are many multifactor, integrated theories of sexual offending behavior. All these theories, steeped in biology, psychology and psychiatry, focus on explanations for sexual offending by pointing to problems within the individual. Despite so much of theoretical and empirical work on these lines, they indicate that the knowledge is still rudimentary and that there is no single pathway that can be used to explain this behavior for all offenders. And again, this means that how we manage sex offenders must take into account their variability. All this is rather disappointing.

There are radical feminists who say that all men are potential rapists. All male sexual behavior is tantamount to rape. All men are violent and warlike. All pornography is violent because it is based on the sexual exploitation and degradation of women. The problem with this view is that most men do not rape. Biological anthropologists, examining this i.e. are men simply prewired to behave badly towards women?—have not found 'boys will be boys' explanation of sexual harassment as the natural extension of maleness or male power, as an acceptable explanation. For, they say that evolution and natural selection have provided simultaneously certain morally desirable traits to all humans—care, empathy, social

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responsibility and accountability—and if men are willing to leverage these traits and can better nurture their expression, there is no reason why sexual harassment cannot wither away (Bribiescas, 2017). At the extreme, the radical feminists' prescription would be ridiculous and atrocious—all male adults should be bobbitised a la Lorena Bobbit!!!

There are Marxist feminists who do not go by what the radical feminists aredently profess. Male violence has not always existed. Rape and sexual violence have not existed throughout human history. They were not there in egalitarian societies of distant past-"...rape and violence against women are neither universal features of human society nor simply theproduct of male biology. Furthermore, since pre-class society accounts for approximately ninety percent of the time human society has existed, the experience of class exploitation, inequality and systemic violence, including violence against women, is an extremely late development in human society." (McGregor, 1989). The Marxist feminists are not foolproof, though. The problem with the Marxists is that, for example, the Indian Left is willing to talk about rape as long as it is in the context of caste and class oppression. This is blatantly incomplete. A middle-class or upper-class woman raped by lower-class men, lower class women raped by lower class men, and a girl raped by men in her own family—such happenings do not fit their narrative. There are Marxist-Leninist-Maoist and other leftist type males who have raped. Leftist ideology is no guarantee that a man subscribing to it will not rape. Intellectuals of all types including some Nobel laureates and even some self-styled god-men and religious priests too have raped. So, what is the way forward to making sense of sexual predation?

My search for a narrative that is non-dogmatic has fortunately met with the book under review, in my college library. After reading, I immediately felt that this open-mindedbook should be a compulsory reading for every boy and man, not just for every girl and woman. For, this is not a rigorous--theoretical and empirical--academic piece. It is an experiential outpouring, an experiential sharing and somewhat reflective writing about others' experiences and perceptions as well—all in one. It may be noted that the author had written undergrad and postgrad academic theses on rape, though.

Rape is nothing but stealing sex. "Rape drains the light...it sucks joy...Rape in any context is sex that you grab, not sex that you negotiate and mutually enjoy...No matter who you are, if someone forces you to have sex, it is rape", says Sohaila, the author, who deals with all kinds of rape—child rape, military rape, police rape, gang rape, viral filmed rape, incest rape, within family rape, date rape, acquaintance rape, stranger rape, war rape, mob rape, marital rape, rape of people with developmental disabilities, etc. Almost everyone—female, male, trans, gender-fluid, gay, straight, bi—and even sex workers, have multiple stories of rape. The reality of males raping females is predominant, though. Rape has become like a go-to-hobby for men of all types. And there are men who rape women, film their actions, and then sell the videos! Women haters who objectify women in order to rape them justify rape. Even old women are not spared! The worst rape is the one in which the victim is murdered, brutally killed.

Any rape is staggeringly horrible. More often, the victims are destroyed beyond repair. Their life, their families, and their careers are devastated. Many victims live a deathly life with their own toxic secrets buried in shame and fear. Women still do not generally have an easy time reporting sexual predation.

Indian law only recognizes the rape of cis women—females who were assigned female at birth. Also, in India, marital rape is not considered a crime. The same is the case in 37 other countries in the world. All the same, according to the Research Institute of Compassionate Economics, the vast majority of rapists are the victims' own husbands.

The author says that some women do lie about being raped but false allegations are extremely rare. This is in contrast to my own gathering of information at the fast track rape courts in Delhi that false cases overwhelm the number of genuine cases.

Sohaila goes through the reasons based on patriarchy, provocative women, alcohol and drugs, and pornography, and admits that why men rape is not easy to understand. Sometimes rape has nothing to do with sex, and sometimes rape does have to do with sex—"Rape and desire, violence and sex. They're all so mixed up. May be they should not be, but they are, and it's a tricky overlap." Rape has historically been used as a political tool by ruling elites. A best way of humiliating, demoralizing and defeating men of a culture, of treating them as inferior, is raping and murdering their women. Whoever has power in family, community and country can trample all over everyoneelse's boundaries. The way we talk about sex, without valuing consent, can feed into rape culture. Some rapists have had terrible lives full of abuse and despair and they give the same back to society through rape. But there are men who have had perfectly healthy, wholesome lives and they too rape! There is rape to cause pain and there is rape to have sex. How women bring up boys also matters. Boys should not be reared to think that they have a free pass to maraud through the world and take without thinking. Sex education, formal or informal, that values consent, does matter.

Women are not responsible for rape. Men are. Sohaila is emphatic about this because, after all, men choose to rape. Women victims do not choose to rape. Rapists have distorted views of themselves and their victims. For example, the rapists of the author of the book thought that she had no right to be out with a boy—she was a bad girl deserving to be taught a lesson and killed!Sohaila is in sync with the view that all men are not capable of rape, though, and thus not in favour of the radical feminist view. She is not in favour of the Marxist view either. There is no dogmatic choice of an explanation in her.

Sohaila also discusses how we should relate to the victims and how the system everywhere operates in relation to them. The victims need unstinting control, acceptance and support. The system everywhere is built to support and condone sexual abuse by men. Trials take time. Court rooms are brutal. Evidence is tricky. Sexual violence is not a priority. Most rapists go scot free or exonerated. Rape is the only crime "to which people respond by wanting to lock up the victims. It's the only crime that is so bad that victims are supposed to be destroyed beyond repair by it, but simultaneously not so bad that the men who do it should be treated like other criminals."

Death sentence or violence against rapists is not the solution. The author is in favour of forgiveness and humanizing the rapist. She empathises with the view of a woman victim thus: "How will we understand what it is in human societies that produces violence if we refuse to recognize the humanity of those who commit it? And can we empower survivors if we're making them feel 'less than'? How can we discuss solutions to one of the biggest threats to

the lives of women and children around the world, if the very worlds we use are part of the problem?"

Let us now get back to the fundamental question that Sohaila poses at the beginning of her book. How have we managed to evolve as a species that is riddled with rape? When did we give ourselves permission to become this way? "Sometimes I wonder if we consider bad table manners a worse breach of protocol than forcing a random object up a personal orifice", remarks Sohaila. What she says at the end of the book is touching: "…I have faith in human nature. Human nature is kindness and large-heartedness, compassion and respect. But human nature is also vile and cruel, selfish and entitled. I've been intimately engaged with all these sides of human nature, and I don't have an answer about what we really are. I do know that we make choices about how we treat each other, and too often the choice is to violate, to tear down and not build up. Does rape come from some primal instinct, or is it an inevitable outgrowth of the way we learn to relate to one another? Are we ever going to figure it out, together? No matter what the answer is, we certainly won't find it if we don't talk to each other."

I find this book a most valuable contribution in recent times toward enhancing life on planet earth, and the author is 'one of us' wanting women to be free of fear. Stop it now, is the clarion call out of this book. She has written the book with an organic touch with the reader who has no choice but to be with her or any woman with full empathy to not only get an idea of the complexity of the issues of rape but also what can be done for a world without rape. It should be a compulsory reading for courses on sexual violence.

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