IMPACT OF THE WTO/TRIPS AGREEMENTS ON THE INDIAN AGRICULTURAL SECTOR WITH SPECIFIC REFERENCE TO RICE VARIETIES

Dissertation submitted to the Jawaharlal Nehru University in partial fulfillment of the requirements for the award of the degree of

MASTER OF PHILOSOPHY

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CERTIFICATE

This is to certify that the dissertation entitled **"IMPACT OF THE WTO/TRIPS AGREEMENTS ON THE INDIAN AGRICULTURAL SECTOR WITH SPECIFIC REFERENCE TO RICE VARIETIES"**, submitted by **Mr. RAKESH KUMAR RANJAN** in partial fulfillment of the award of the degree of **MASTER OF PHILOSOPHY** in **Jawaharlal Nehru University** is original work according to best of my knowledge and may be placed before the examiners for evaluation.

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ABBREVIATIONS

AOA	AGREEMENT ON AGRICULTURE
TRIPS	TRADE RELATED ASPECTS OF INTELLACTUAL PROPERTY RIGHTS
WTO	WORLD TRADE ORGANISATION
GATT	GENERAL AGREEMENT ON TRADE AND TARREIFS
IPR	INTELLACTUAL PROPERTY RIGHTS
PVP	PLANT VARIETY PROTECTION
PBR	PLANT BREEDER RIGHTS
PVPFR	PLANT VARIETY PROTECTION AND FARMERS RIGHT
IU	INTERNATIONAL UNDERTAKING
CBD	CONVENTION ON BIODIVERSITY
CGIAR	CONSULTIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH
ICAR	INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MOEF	MINISTRY OF ENVIRONMENT AND FORREST
GM	GENETICALLY MODIFIED
IRRI	INTERNATIONAL RICE RESEARCH INSTITUTE
CRRI	CENTRAL RICE RESEARCH INSTITUTE
DRR	DIRECTORATE OF RICE RESEARCH
FR	FARMERS RIGHT
MOCAFPD	MINISTRY OF CONSUMER AFFAIRS, FOOD AND PUBLIC DISTRIBUTION
FCI	FOOD CORPORATION OF INDIA
IPP	INTELLECTUAL PROPERT PROTECTION
MT	MILLION TONNES
WIPO	WORLD INTELLECTUAL PROPERTY ORGANISATION
PFC	PATENT FACILITATION CENTRE

M. Ha.	MILLION HACTARE
IARI	INDIAN AGRICULTURE RESEARCH INSTITUTE
TIFAC	TECHNOLOGY INFORMATION FORECASTING AND ASSESMENT COUNCIL
DBT	DEPARTMENT OF BIO TECHNOLOGY
CSIR	COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
DSIR	DEPARTMENT FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
SAI	SEED ASSOCIATION OF INDIA
GR	GREEN REVOLUTION
NGO	NON-GIVERNMENT ORGANISATION
DARE	DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION
FAO	FOOD AND AGRICULURAL ORGANISATION
GRAIN	GENETIC RESOURCES ACTION INTERNATIONAL.

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Chapter – I

Introduction

"Of all diseases, hunger is the greatest...

There is no other treasure equal to that of rice."

-Gautam Budha

1.0. Significance

Intellectual property as the name indicates is the creation of human, the product of imagination of mind or of objective thinking.[1] Though intellectual property assumed commendable importance in recent parts, its origin dates back to some European countries.[2] Intellectual Property Rights (IPRs) confer on the owner a monopoly of production and distribution of products in a specified territory for given period of time along with social obligation of disclosing information.[3] IPR are of different types like, trademarks, industrial design, copyrights, plant variety protection, geographical indicators and patents.

The coming into force of IPRs and agreement on agriculture is far from consensus. Developing countries like India are facing a tough battle against time in safeguarding their natural resources under changing global environment. This situation has arisen after establishment of the World Trade Organization w.e.f. 1st January 1995, of the several World Trade Organization (WTO) agreements; its agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) is of great significance for most developing countries since ratification by member countries implies important change in their respective intellectual property laws. It is very important to mention that, at the time of signing of the WTO agreements, IPR laws in developing countries were in nascent stage in comparison to developed world, whose laws or institution are

[1] Gupta, A.K. (1999)
[2] See annexure-I
[3] Desai, P.N. (2003)

at par with the TRIPS agreement. By the enactment of TRIPS, the IPR became an issue of debate between north and south. The word like life patent and plant variety protection act emerged in front of developing world for the first time. Patent on life (Bio-patent) is not new for developed world but in case of third world it is new one. The question was in front of developed world is to accept the TRIPS in which suitable manner that will fit for their needs and requirements. After global acceptance of WTO agreement, the dimension is totally changed in case of life science industry like plant and pharmaceutical sector. The mechanism and instrument of life patent has negligible presence in third world countries. Most of the debate after TRIPS agreement focused on pharmacy sector and biotechnological revolution in plant science. The concepts of traditional knowledge, bio-piracy, biosecurity and food security of country like India in new global regime have to be analysed. India has large number of crop varieties having diverse centres of crop diversity and its climate is suitable for different types of crop and herbs. Therefore, concerns are expressed that the new liberalized regime might have some impact on rich genetic heritage and bio-wealth of India.

There is also a debate initiated after the onset of biotechnology in agriculture sector. The transformation of Indian agriculture from green revolution to evergreen revolution has several vistas, angles and shapes. It is argued that green revolution is based on public technology owned by the public and used for the betterment of the public[4]. Whereas, transgenic technology is seen as a tool for commercialization, commodification and monopolization of agriculture sector *in toto.*[5] It is argued that new technology is based on proprietary system. The country has witnessed the case of GM Cotton, the only approved crop in India by the Genetic Engineering Approval Committee (GEAC) under auspice of Ministry of Environment and Forrest (MOEF).

1.1. Background of the Study

The coming into force of WTO agreement involving TRIPS has brought both opportunities and threat to the developing countries, though there exist little

[4] Sahai, Suman (2004)
[5] Shiva ,Vandana (2002)

convergence of opinion on these aspects. It is argued that the TRIPS agreement has changed the international governance of Intellectual Property Rights (IPRs) radically. TRIPS have sought to establish enforceable universal minimum (and high) standards of protection and enforcement. TRIPS has incorporated provisions from many existing international IP agreements, introduced new obligations and higher protection standards by mandating extension of patentability to virtually all fields of technologies recognized by the developed country patent regime and by prolonging the patent protection.[6]

The proponents of the TRIPS agreement argue that it will provide free trade era calls for effective protection of wealth of developing countries. Some also argue that there is also possibility of reshaping of agricultural institution and organization meant for research and development activities due to the new global scenario. As the welfare state, the concern is to feed overgrowing population to maintain food and nutritional security and the judicious use of new technology in our own frame with the fulfilment of international mechanism of IPR is the major task for economist, agronomist, social scientist and all other concerned. The science and technology has changed the scenario of hunger problem in India up to some extant. This was due to adoption of high input responsive technology. This technology has some geo-political and socio-economic consequences.

Traditional concepts of factors of production are also changing in the time of liberalized economy in case of agriculture and allied activities. The role of knowledge as potential contributor to production is increasingly being recognized, thus assuming the status of a factor of production .Not only gathering and or generation of information and technology, but its effective protection is also vital in new order of international relation and multilateral trade in agriculture. Traditional knowledge, ancient wisdom and even folklore technologies are now viewed as a potential contributor to technology generation. Indian economy is based on agriculture, which provides 22% of GDP contribution and approximately 60% employment. How our planner will shape the new IPR norms that will suit our condition is the most vital issue after the TRIPS.

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[6] Desai, P. N. (2003)

Concerns are expressed in many quarters that the introduction of new IPR in agriculture may led to the erosion of genetic and biological diversity of many cultivated crop species as more and more would be occupied by genetically modified crops .This may result in narrowing the genetic base of cultivated crops like rice and wheat and in turn it may led to uniformity of genetic base would have its implication on susceptibility to diseases and pest and spontaneous out break of biotic stresses.

The extant and degree to which IPR influences productivity increase is still to be assessed in Indian condition because it has not witnessed the cereal crops in this context. There is a chance that the commercial crops may push the vanguard crops like rice and wheat in back stage due to high private sector investment in research and monopolization of seed market by transnational corporate as well as many environmental and ecological threats in many high productivity zones of the cereal crops.

1.2. Focal Point of the Study

Scientifically, Rice is an annual grass belonging to the tribe "oryza" of the natural order Gramineae.[7] This is a cereal[8] crop. Selecting a crop like rice (*oryza sativa* L.) is justified in Indian context because it provides means of livelihood, employment, food and nutritional security of India. Rice is cultivated on 43 M.Ha. Of cultivable land which is approximately 35 percent of cultivable land (148 M.Ha.) and approximately 13.1 % of geographical land (328M.Ha).The production of rice ranges between 85M.T. to 85.3 MT which is approximately 40 % of total food grain[9]. Globally, wheat is the staple crop for the masses but in context to India, rice is the major food which maintains the food security of the nation from Kashmir to kanyakumari and Leh to Kohima. Analyzing the data of rice production of last five

[7]Church, A. H. (1983) Rice (Oryza sativa L.) Food Grains of India, Ajay Book Store New Delhi India, First Edition pp 66-76.
[8] The word "cereal" is derived from "ceres" which is the name of a roman goddess, regarded as giver of grain
[9]Calculation based on Table No.1.

years (from 2000 to 2005) clearly indicates the stagnation of the production of rice[10]. The impact of green revolution is now showing fatigue ness, so adoption of new technology in context to rice is demand of the time to maintain the food and nutritional security of the nation.

Rice is the staple food of masses in Indian subcontinent. The world's major rice producing countries –including the two most populous countries, the Republic of China and India –have emphasized the importance of continuing to develop new varieties to guarantee not only household food security but Asian food security and support the regions economic, social and cultural development.

The introduction of Plant Variety Protection Rights and the continued implementation of the International Treaty on Plant Genetic Resources for food and agriculture have clearly had an impact on the development of new rice varieties especially the exchange of material between countries. Under the treaty, all countries that ratify it must agree to facilitate access to their plant genetic resources (including rice) for food and agriculture. In turn, those involved will share-in a fair and equitable way-the benefits arising from the use of these plant genetic resources.

Rice is the focal point and a public good through which the interdependent relationship among agriculture, food security, nutrition, agro-biodiversity, the environment, culture, economics, science, gender, poverty-alleviation and employment may be clearly assessed in post TRIPS regime. The present study is concerned to find out a way to understand the relationship between science and society, through rice improvement and breeding programme. To develop a strategy for analysing science, society and humanity through rice improvement and development and to address the concern of food and nutrition security, equality, equity and balanced and harmonized growth of different regions, situation and system is major concern for developing world.

This is revealed with fact, figures and assumptions that no any other economic activity feeds so many families, so crucial to the development of so many nation of

[10]Analysis based on Table No.1.

particularly the third world and has more impact on environment. Rice production feeds almost half of the planet each day, provides most of the main income for millions of poor, rural household, helps insure social stability in some of the world's largest nation and covers 11% of the earth's arable area. It is argued that this is a part of Asian culture and the unstated religion of Asia, and in essence rice is the lifeline of Asia .Nearly 91% of world rice is produced in Asia.

The fears are expressed that due to emergence of transgenic technology, there may likely to have a chance that it will fall under the control of the biotechnological industry. This is argued that Trans- national corporate are aiming to capture huge market in Indian seed sector, where farmers still save seed from their rice harvest for planting the next season. The best way to do this? Use science to stop the reproductive capacity of rice or use law to patent the plant, so no one can commercially exploit it without permission of concerned authority[11].

The opponents argues that the real impact to expect from genetically engineered rice is not how it might feed Asia, but how it will expand the wealth of Trans Nationals poised to enter the Rice market in Asia. IPR may be seen as a key component of this strategy to monopolies the grain market and business of third world countries. It will also hamper the issue of food security in context to Latin America, South Africa and Asian Sub-Continent.

The impact of more active participation of private sector seed industries have to analyse at several dimensions. The proponents are in favour of that due to timely availability of quality seed for rice but opponents argued that Rice is on the front line and rice research in the public interest will be severely affected. This may provide a good example of conversion of public good into private good. According to IRRI report-"the main worry is that[Plant Variety Protection]and [Intellectual Property]

[11] Benbrook, Rachel , C(2000) "Rice research losing the patent bottle" ,Against The Grain ,Vol. 1. March 31,2000
http://www.grain.org assessed on 13/2/2006

legislation, if not properly handled ,may restrict the free exchange of the genetic material or seeds, needed by scientist to develop to new high yielding varieties".[12]

It is argued that transnational corporate may usurp the third world crop genetic resources by means of new mechanism like patents. At present over 160 patents have been granted in the field of rice biotechnology worldwide, over half of them are held by 13 companies in the industrialized country. If patents on the life are accepted in Asia, rice scientist will have to pay to use genetic resources and technologies, and the bill will be passed on the framers.[13]

The development of vitamin A –fortified golden rice,[14] which has been so highly, commended in western press, involved warding through no less than 70 patents, according to Dr. Peter Bayer of the University of Freiberg, one of the scientists who developed the rice. He himself is a party to a patent application on it. IRRI argued that golden rice will be available for free. After complex licensing negotiation, it might be. But that does not answer the question –who will pay for it? The big corporation keeps arguing that patents are needed to recoup their R & D costs. A little bit of charity might win them some public relation points in the short terms but it wont support their investment.

Each country has its own law to regulate patents and its infringements can be proceeded against as per the law of that country alone. The patent owner gets the right to enforce the law. Article 27 of the TRIPS agreement provides that the WTO member state shall provide patents for any invention, either a product or process provided that they are new involve inventive step and are capable of industrial application. Thus, before a patent can be granted it should be shown that the invention is novel and useful; and not so oblivious to anyone interested in this subject. It should also be capable of practical implication. The American law insists that the protected subject must be use full and British law will grant a patent only if the invention is capable of industrial

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[12] ibid
[13] ibid
[14] Golden Rice is a transgenic variety of rice, which has genes for the synthesis of Beta- Carotene. These genes are taken from the garden favourite *Narcissus pseudonarcisuss* (Daffodils) and inserted into the genome of a temperate strain of rice

application. The latest trend is to apply the Swedish principle under which a patent can be granted for discovery hitherto unknown application even in respect of an already popular product.

The requirements about usefulness and not being unknown earlier, came into prominence in the context of certain herbal remedies and farmers right prevalent in India from ancient times. There was a Convention of Biodiversity under the UN auspices in July 1999 when the issue of TRIPS vis-à-vis the rights of farmer came to be debated. The TRIPS agreement became controversial because it recognized patents on plant developed through biotechnology using plant varieties that themselves are the result of years of cross breeding by farmers. It does not recognize the rights of communities over their intellectual resources but concentrate on the rights of individuals and companies claiming the patents as their own investment.

Many a times it is argued that interest of Indian farmer will not be hampered due to new IPR regime since majority of Indian farmers use farm saved seeds. In the new regime ,farmers are completely free to use farm saved seeds of a protected variety for growing subsequent crops on his own land or on leased land or for traditional exchange in the village community. Once he converts into commercial seed sector, he is not permitted to sell the seeds of protected varieties without prior permission and he can be booked for breaching the IPR norms in that case.

The impact of IPR on seed price is quite unknown, with the most important assumption being as obvious increase in seed price and other agrochemicals. But as far the increase in seed price is compensated by the increase in the productivity and increase in the relative stability of prices, there is a little room for apprehension of its adoption by the farmers.

1.3. Biodiversity and Biopiracy

The third world countries are rich in biodiversity. "Indian subcontinent is bestowed with great diversity in agri-horticultural crops; of this 8900 species are of ethno botanical importance. Around 75-80 % of population of developing countries

depends on this genetic wealth for their livelihood and medicinal purpose"[15]. Due to wide geographical and biological diversity India has been divided into 16 different agro climatic zones, 10 vegetative zones and 10 biotic provinces.[16]Concerns are expressed in many school of thoughts that the introduction of IPR may lead to erosion of biodiversity of cultivated crop as more and more would be occupied by transgenic crop .It is argued that transgenic crop will hamper our crop genetic variability by promoting monoculture of a single trait specific crops.

1.4. Pattern and Direction of Agricultural Research and Development in new IPR regime

There is also a positive argument that Introduction of IPR norms may result increased resources allocation to research .The hypothesis of IPR induced inflow of fund towards research still is to be verified. Along with the total allocation of research funds, the area of attention is also important. The possibility of channelising a lion's share of privately funded research towards high profit oriented elitist technology can not be ruled out. The oblivious opinion on the part of government will be to monitor the quality as well as the funds allocation towards research and bring the necessary guidelines to protect the interest of farmers and breeders.[17]

The opponents also argue that the new IPR regime under the WTO/ TRIPS auspices is more stringent than the existing one in India, encompassing more monopoly elements. This gives the innovator more incentive and protection and calls for more investment in research and development. However, its impact on developing countries like India is to be examined particularly on public sector research system.

India was a founder signatory with 23 countries for establishment of GATT (General Agreement on Trade and Tariffs) as early as in 1948 to promote and regulate international trade. However, the signing of multilateral world trade agreement by India

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[15] Kamboj,V.P.,2000 Herbal Medicine ,current science ,78(1):35-39

[16] Ghosh,S.K.2000,Biodiversity and IPR-Ethics and Politics, Journal of Intellectual Property Rights,5(4):196-205

[17]A. Suresh and Dr. Puran Chand(2004) Trade Related Aspects of Intellectual Property Rights: An Evaluation , Kurukshetra, April 2004.pp21-26

along with 124 nation states in April 1994 transferring GATT into special significance. The world trade agreement (WTA) under the auspices of WTO includes an agreement on Trade Related Intellectual Property Rights (TRIPS) according to which India as a member state, is obliged to enact and enforce a system of plant variety protection (PVP) either by patenting or by any effective sui generis system (an unique system of its own kind) or any combination thereof.

The conclusion of the protracted Uruguay round of multilateral trade negotiation marks a major leap forward in international trade liberalization. The final act was signed in April 1994 at Marrakech, Morocco. With this old general agreement on trade and tariffs was replaced by the new multilateral trade regime known as the world trade organization (WTO) with a membership of 136 countries as on 1st January 1995. The most avowed goal of the WTO as set out in the promoting documents is to create a fair and equitable, rule based multilateral trade system. The most appealing aspect is that the new multilateral trade regime would be transparent and non discriminatory. For the world trading community as a whole, every initiative on trade liberalization should insure rewards in the form of large and expanding market, and the greater trade flows for all participating members.

1.5. WTO Agreements Related to Agriculture

The WTO agreement consist of 29 individual legal texts, covering a wide range of subjects from agriculture ,textile and clothing and services to government procurement, rules of origin and intellectual property and environmental and sustainable development concerns. Added to these are more than 25 ministerial declarations, decisions and understandings. The agreement on agriculture (AOA) having 21 articles forms a part of the final act.[18]

[18] Sompal (2002)

1.5.1. Agreements on Agriculture (AOA)

The long term objective of the AOA is to establish a fair and market oriented agricultural trading system .A reform process should be initiated through the negotiation of commitments on support and protection and through the establishment of strengthened and more operational effective GATT rules and disciplines. It also undertakes to provide for substantial progressive reductions in agricultural support and protection sustained over and agreed period of time, resulting in correcting and preventing the restrictions and distortion in global agriculture markets. Broadly there are four areas under the AOA, whereby member countries are required to adhere to commitments and one other area the agreement of on Trade Related Aspects of Intellectual Property Rights (TRIPS). These are:-

1. Market Access
2. Domestic Support Measures or the Aggregate Measures of Support (AMS)
3. Export Competition or Subsidies
4. Sanitary and Phyto Sanitary Measures and
5. TRIPS

1.5.2. Agreement on Sanitary and Phytosanitary Measures

The Agreement recognizes that Members have the right to adopt or enforce measures that are necessary to protect human, animal or plant life or health. This right is subject to the condition that such measures should not act as a means of arbitrary or unjustifiable discrimination between Members as a disguised restriction on international trade.

1.5.3. Agreement on Technical Barriers to Trade

The Agreement is for the establishment of international standards and conformity assessment system in packaging, marking and labelling, so as to ensure that

technical regulations and standards, and procedures for assessment of conformity with technical regulations and standards do not create unnecessary obstacles to international trade. No country should be prevented from making provisions to ensure the quality of its exports, or for the protection of human, animal or plant life or health, of the environment, or for the prevention of deceptive practices.

1.6. Trade Related Aspects of Intellectual Property Rights

This Agreement is made to promote effective and adequate protection of intellectual property rights and also to ensure that the measures taken in this direction do not become an impediment to legitimate trade. It is through Article 27.3(b) of the Agreement that the subject of agriculture is brought under this Agreement.

This issue is related with IPR in agriculture. It must be realized that there has to be a comprehensive legislation or act on patenting. Its absence has cost India heavily as other countries have taken advantage of large scale patenting. India has witnessed several cases of biopiracy, due to lack of patent mechanism. India has incurred a great deal of expanse by loosing a large number of patents and entering into unnecessary legislation. Second, the biodiversity conservation act (BCA) and plant variety protection act (PVP) to save India's genetic resources from misuse, plunder and overexploitation and protect the rights of its farmers and researchers, have become absolutely essential. The plant variety protection act came into existence after autumn of 2001 and biodiversity act should have been introduced much earlier[19].

The third equally significant aspect of IPRs is India's stand on patents which have already taken or filed by the developed countries based on our germplasm and traditional indigenous knowledge. These include Basmati rice, Neem, Haldi, and Amla or other products know to us through the traditional medical formulation. Geographical indication and appellation of origin constitute IPRS that are distinct from patents. Furthermore patents can not be granted for knowledge that is already in public domain.

[19] Sompal(2002)

In India the concern for the protection of intellectual property was evident way back in the design act of 1911.Later the patenting system was modified and a comprehensive act viz., Indian patent act was passed on 197O .Prior to the agreement on TRIPS India had legal system of protection for four types of intellectual property like patent, trademarks, copy rights and industrial design. In view of TRIPS article Indian government amended 1970 patent act to incorporate issues of plant patent as well acceptance of both process and product patent in recent years.

Besides a rich biodiversity, India has an abundant wealth of agricultural ideas, techniques, products and processes. Being a country with a long and varied past many of its knowledge and practices relating to agriculture has come down through generations. These traditional knowledge and practice have found many modern applications. On the basis of India's rich biowealth, one argued that India may take benefit from TRIPS, if its traditional knowledge is documented and registered properly.

However India's rich reservoirs of the traditional knowledge and practices are under threat from MNCs and usurpation elements, which are quick to grab the opportunity to patent our knowledge and practices in western countries. India needs to put in place effective steps to protect them. Proper documentation of these knowledge and practices should be the first step in that direction.

1.7. Post-WTO Indian Legislation Pertaining to Agriculture[20]

Under the changing dimension of agriculture under auspices of TRIPS, government of India formulated different acts, legislation and amendments to compete with global counterparts so far the agricultural research and development is concerned

1.7.1. Protection of Plant Variety and Farmers' Rights Act, 2001

The Act is for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of

[20] Ibid.p411

new varieties of plants. This Act is to give effect to Article 27.3(b) of the Agreement on Trade Related Intellectual Property Rights, India having ratified the Agreement on Trade Related Aspects of Intellectual Property Rights. The Act recognizes the necessity of protecting the rights of farmers in respect of their contribution made in conserving, improving and making available plant genetic resources for the development of new plant varieties. The Indian act seems to be a role model for developing world, because it provides recognisation of farming community for their contribution in conservation of crop genetic resources and also providing reward system for breeders to encourage them for better research for sake of public welfare.

This act also provides a way for new institution like plant variety and farmers right authority. This act also provides a way for setting up of new gene banks for conservation of germplasm. India did not accepted UPOV model of plant variety protection but it adopted several positive elements from UPOV.

1.7.2. The Geographical Indications of Goods (Registration and Protection) Act, 1999

According to the Act, the term 'geographical indication', in relation to goods, means an indication which identifies such goods as agricultural goods, natural goods, or manufactured goods as originating, or manufactured in the territory of a country, or a region or locality in that territory, where a given quality, reputation or other characteristic of such goods is essentially attributable to its geographical origin. In case where such goods are manufactured, one of the activities of either the production or of processing or preparation of the goods concerned takes place in such territory, region or locality, as the case may be.

The Act is for the exclusion of unauthorized persons from misusing geographical indications, add to the economic prosperity of the producers of such goods and also promote goods bearing Indian geographical indications in the export market. Unless a geographical indication is protected in the country of its origin, there is no obligation under the TRIPS Agreement for other countries to extend reciprocal protection.

1.7.3. The Patent (Second Amendment) Act, 2002

(A) The non-patentable aspects of the invention are specified. This includes plants, animals in whole or any part thereof, including seed varieties and essentially biological processes for the production or propagation of plants and animals.

(B) Micro organisms per se can be claimed provided; they are not mere discovery of organisms existing in nature.

(C) Methods for rendering plants free of diseases or to increase their economic value will be patentable.

(D) The Act of 2002 makes it mandatory to deposit the biological material mentioned in the specification with a depository notified in the Gazette of India. The source and geographical origin of the biological material must also be disclosed in the specification.

1.8. Food Security

Food security defines a situation in which people do not live in hunger or fear of starvation. Worldwide around 852 million men, women and children are chronically hungry due to extreme poverty, while up to 2 billion people lack food security internationally due to varying degree of poverty[21].FAO define food security as-"food security exist when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life."

One of the most vital issues concerned with the third world countries regarding WTO/TRIPS regime is fulfilment of the food and nutritional security. Although the countries of south are provided with rich natural resources and different varieties of crops, but due to traditional mode of practicing agriculture fulfilment of the dietary requirement of their population is a daunting task. It is argued that WTO promotes commercialization of agriculture. It also provides better opportunities to modern

[21] FAO,2003

technologies in agriculture. The emergence of biotech is major feature of global agriculture after the WTO enactment. Most of the laws of WTO are in conformity with the countries of the north.

Due to the deference in food habits of developed countries and developing countries, the dimension of food security is also differing from one part of the globe to other part. Cereal crops like wheat and Rice and millets like Jowar, Bajra and Ragi are grown and consumed in third world countries. In the fast changing economics of agriculture, the cultivable land of third world also came under commercial crops to enhance more benefit in global agri-market. The pattern of cropping is changing from food crops to cash crops and also investment in agricultural research and development is tilted more towards commercial crops. This type of situation will must have some impact on food security. The changing pattern of more thrust on low volume but high return crops may have impact on food security.

The agricultural biotechnology revolution has both positive and negative impact on the food security of third world countries. This is argued that judicious application of biotechnology may fulfil the food requirement both in quantity and quality. Golden A rice project is noteworthy example in this context. Use of biotechnology may invent trait specific varieties suitable for a particular agro-climatic region. The planners, policy makers and agricultural scientist of various nations in the south and west Asia have been engaged in alleviating poverty, improving food security ,and reducing malnutrition ,by using new technologies in eco-friendly and sustainable manner. This is also argued that the tools of biotechnology like genomics, bioinformatics, transformation and molecular breeding will provide better path for agricultural research to maintain the food security of nation. Therefore, it is argued that, a holistic approach is needed for the agriculture sector in new IPR regime to fulfil the requirement of all the stakeholders of the society.

Dr. M. S. Swaminathan (2000) argued that "we need to examine how science can be mobilized to raise further the biological productivity ceilings without associated ecological harm. Scientific progress on farm, as an evergreen revolution, must emphasize that the productivity advance in sustainable over time since it is rooted in the

principles of ecology, economics, social and gender equity, and employment generation"[22].Technological advancement of science can solve the problem of hunger and malnutrition in third world agriculture if it is regulated in suitable manner by the welfare state like India.

The tool of IPR in agriculture like patents, geographical indicators and plant variety protection acts is likely to have some impact on food security. The impact of the provision of TRIPS on food security is yet to be analyzed. The restructurisation of existing institution of agricultural research and development to fulfil the concept of food security is need of the time which is influenced by the new regime. The step is already taken by the government of India by enactment of New Seed Policy, Biodiversity Act and Plant Variety Protection act which will streamline the concept of food security.

Food security has its dimension from the international level to global level. It encompasses the production as well as the accessibility and purchasing power of the individuals. The issue of food security has its own gender dimension also. The fundamental aspect of food security is the production of sufficient quantity of quality food capable to fulfil the nutritional needs of the masses.

There is the chance that commercial crops may push the food crops to backstage due to high private research investment in cash crops as well as many environmental and ecological threats in many high productive zones of the country. Secondly, the quality parameters of food with regard to its nutritional utility. IPR may provide a better condition for cultivation of transgenic to fulfil the nutritional as well as quantities requirement of poor masses. However, it may lead to monoculture of crops which will narrow down the genetic variability and in turn led to genetic erosion of our rich agro biodiversity. In the new IPR regime monoculture of specific crops will create several other problems like insect pest resistance.

Country's food production jumped from about 50MT. to over 200MT. in fifty years or so is to state the obvious. Based on requirements of between 2200-2400 kilo

[22] Swaminathan (2000)

calories deemed necessary for leading an active life ,it is estimated that per capita per day consumption should be 425 grams of food grains, 60 grams of proteins and about 20 grams of fats. Based on this premise food grains (cereal)requirement for a billion population will be about170-175 million tones and for a projected population of about 1.3 billion in 2020 it is likely to be about 190-195 million tones for human consumption.[23]

1.9. Objective of the Study

To address and analyze the condition of Indian agriculture in respect to new Intellectual property rights is the major concern for present study. WTO affected the agricultural situation of third world countries in different manners. After emergence of WTO in global arena, particularly TRIPS reshaped and redirected all the existing pattern of agricultural research and development, production and productivity pattern of crops as well as investment in agricultural innovation. The new regime of patent and plant variety protection will must have impact on practices of our farmers. The impact of transfer, diffusion and dissemination of new technology on Indian agriculture should be assessed in context to new regime.

Rice is the suitable medium by which one may analyze several socio economic and geopolitical condition of society. In context to science –technology-and society, rice –IPR –Biotechnology may provide a noteworthy example to assess the impact of TRIPS on Indian society.

Following are the some major objectives of the present study

(1) Critical analysis of impact of TRIPS article 27(3)b on Indian Agriculture with specific reference to rice improvement and breeding programmes.

(2) Analysis of policy initiative taken by government for safeguarding the interest of all the stakeholders under the obligation of new IPR regime in crop variety development and improvement programme.

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[23] Taimini K .Brij (2001); vision for 21st century, Food Security in 21st Century Perspective and Vision Konark Publication Limited pp148-175.

(3) Analysis of Impact of WTO in context to IPR on agricultural R &D (investment pattern and direction of research), seed sector, biotechnology, and biodiversity and food security.

(4) Study of patent in India from colonial patent rule to post independent post TRIPS patent rule in general and life patent (plant patent) in particular.

(5) Impact of new trade liberalized regime on agro-biodiversity and traditional knowledge in context to crop genetic resources.

1.10. Analytical Framework

(1) In the context of TRIPS article 27.3(b), what are the instruments and mechanism that developing countries look up in order to efficient and effective management of the agricultural R&D for new varieties development and formulation in cereal crop like rice for food security?

(2) Can IPR help in the innovation and invention of new rice varieties?

(3) What are the possible impact on rice varietal diversification in context to adoption of new technology and IPR?

(4) What should be the direction of agricultural research and what is the changing dimension of Indian agriculture under the auspices of TRIPS?

(5) Is IPR a device to restrict science to perform its social role or to achieve social goal of science?

(6) Is plant-patent an institutional norms of science or the institutional norms of political dictatorship?

(7) Whether the new IPR regime will be able to enhance the scientific and technological capability to cope up with the emerging technological, social and legal problem?

The theoretical analysis of present study is based on the various intermingled issues of science, technology and society. This is an attempt to know the relationship

between science and society in new global regime. How the tools of sciences like IPR and Patent influences scientific community and commons like farming community is the major concern of present study.

The patent provides benefit to innovators by rewarding them but it also excludes others for its use. So it provides example of rights to excludes. "Patents proclaim exclusive rights of use and, often, non-use".[24] Patent holders want to maintain secrecy of its invention due to motivation of more economic incentives. "The institutional conception of science as part of the public domain is linked with the imperative for communication of findings. Secrecy is the antithesis of this norm; full and open communication its enactment".[25]

Scientist have also two schools of thought, one group are in favour of voluntary disclosure of their invention for serving humanity by means of informed citizenry to advance the status of masses but other group want to maintain secrecy. But, it is argued that "Science flourishes and scientist make progress in an atmosphere of free enquiry or free interchange of ideas with the continued mutual stimulation of active minds working in the same or related fields. Any imposition of secrecy in science is like application of a break to progress".[26]

Modern technology has both fruitful and adverse impact on commons. It depends on the state and society how to use the scientific advancement for upliftment of the masses. Biotechnology revolution may be analyzed in this context. This technology may make free India from hunger and malnutrition ,but there is also threat for commercialization of third world agri market and also monopolization of production by transnational corporate, but so far policy issues is concerned biased view for fulfilment of desire of anyone stakeholders can not solve the problems of our masses." Science is a dynamic force of social change, though not always of changes foreseen and desired. But science has social consequences also".[27]

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[24] Merton, Robert K.(1968) Social Theory and Social Structure, The Free Press, New York.p612
[25] Bernal. J.D, *The Social Functions of Science.p150-151*
[26] Merton, Robert K.(1968) *Social Theory and Social Structure,The Free Press,new york.p588*
[27] Ibid.p585

"As an institution IP laws has two purposes; the protection of individual rights and the promotion of general welfare. These two purposes exit in tension, and this tension is the source of intellectual conflict".[28] New patent and IPR regime up to some extant ignore the contribution of traditional farmers and artisans for the conservation of nature and natural resources. In case of agriculture most of the varieties are developed by the genetic resources conserved by the resources poor gene rich informal innovators. But scientific advance involves the collaboration of both past and present generation.

New IPR regime emphasizes on the individual ownership of invention: which is against the Mertonian ethos of science. "The communism of scientific ethos is incompatible with the definition of technology as "private property" in a capitalistic economy".[29] Property rights in science are against the second ethos of science because finding of science are a product of person (scientist) with social collaboration and community.[30]

The relationship between science ,and society may be examined at two levels. First from the stand point of nature of activity of science itself, Second from the stand point of relationship between science and society; that is way science is affected by social forces and manners in which science influences society.

The ethos of the social institution of science is taken to include universalistic criteria of scientific validity and scientific worth, thus involving values easily integrated with the values of a free society in which it is men's capacities and achievements which matter, not their ascribed status or origin. From the sociological point of view, the place of science in the totalitarian world is largely the same as that of all other institution except the newly dominant state''.[31]

"In the post 1990 era the traditional autonomy of science and its rules of the game,-it's either,-in short challenged by the external authority". It may be argued that the external authority may be transnational corporate and state.

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[28] Evanson,R.E and Puntam,J.D .Institutional Change in Intellectual Property Rights :American Journal of Agricultural Economics,Vol.69.No.2(May 1987)pp403-409

[29] Merton. R.K, *Science and Social Structure* , The Free Press, New York .p 612

[30] Ibid.p612

[31] Ibid.609

Rice is the public good which may be converted into private good due to new IPR regime. Public good is based on disclosure, open knowledge and free circulation of information where as market good is based on IPR and knowledge as 'commodity' and private property and thus retention of information which promotes secrecy in results.[32]

A holistic approach is used to understand different arguments in favour and opposition of Intellectual Property Rights. Policy formulation is based on the adoption of several ideas, thoughts and expressions. The different components of science and technology may be used for the betterment of society, if they are used in judicious, efficient and equitable manner.

1.11. Research Methodology

The study is based on the primary and secondary data obtained from various source. The secondary data is obtained from Annual reports of Indian Council of Agriculture research (ICAR,) Department of Biotechnology (DBT), Department of Scientific and Industrial Research (DSIR) and Council of Scientific and Industrial research (CSIR).Study of press release of IRRI, Philippines and FAO depository network, India development records, Economic survey of India and Hindu survey of Indian agriculture is done for theoretical Knowledge. An interdisciplinary approach was adopted to know the various features of IPR in Agriculture.

Various issues of Economic and Political Weekly (EPW) related to WTO and Indian agriculture and also Journal of Intellectual Property Rights is also studied for the drawing of ideas about IPR. Simple statistical tools like percentage ration and comparison is used.

[32] Krishna ,V.V(2001)Changing Policy Cultures, Phases and Trends in Science and Technology in India, Science and Public Policy, June 2001,Volume 28,No. 3,June 2001

1.12. Limitation of the Present Study

The IPR is very complex issues and understanding it in a short term is very difficult task. Most of the post WTO debate is based on the genetically modified crops and pharmaceuticals sector, so there is unavailability of study materials regarding cereal crops like rice. Bio-patent particularly plant patent is very new issue for Indian research and development organization so lack of study materials about concerned subject is obvious. Institution and organization which acts as nodal agency for patents and intellectual property rights are at nascent stage, so up to some extant, they are also not capable of providing adequate and exact information and data. Lack of time and resources also cause some problems to fulfil the academic ethos of present study. However, an honest and unbiased effort has been made from this side to understand the issues and present a crystal clear picture of the concerned study.

Chapter – II

Review of Literature

Indian agriculture has witnessed several changes from freedom to till this date. In year 1947, India got independence from British rule but they left here problems of hunger, malnutrition, food and social insecurity because the colonial regime overexploited India's rich biowealth and natural resources. Colonial rule used India as a place for raw material generation and as a market for manufactured goods of contemporary trans-nationals. British rule did not want to develop scientific and technological capability among Indians. They also hampered Indian agriculture and cottage industry. But, after independence need of technological self -reliance was realised in every sector. Several steps have been taken to boost the technological capability of the nation, and agriculture had given major emphasis by policymakers. The major emphasis of first two five year plans of India was to give strength and shape the Indian agriculture. In decades of 1960-70 India witnessed the green revolution by adoption of high input responsive technology in Indian agriculture and got freedom from severe hunger problem up to some extent and import dependency in food grain sector.

After 1990, globally a major change occurred in all types of international trade and several changes are still occurring to accept the challenges, opportunity and threats under the obligation of WTO/TRIPS. This has also affected Indian agricultural sector in several dimensions. A new era of debate is initiated at different levels of society about biopiracy, biosecurity, traditional knowledge, biotechnology and intellectual property rights. Keeping theses issues in mind, a comprehensive review of literature has been done to understand several factors and its implication on agricultural sector, which is presented below in following sub-heads:-

2.1. Green Revolution vs. Evergreen Revolution: Several Dimensions of Technological Transformation

Suman Sahai (2004) stated that the green revolution (GR) it may be recollected was a publicly owned technology, belonging to the people. The research was conducted with public money to fulfil a public need namely inadequate food production, and it created public goods which everyone has access to. There were no IPR, no patent vested in multinational companies, no proprietary technology or product. The ownership of GR was vested in farmers. On the contrary, the 'evergreen revolution' is a privately owned technology, six corporations (Monsanto, Syngenta. Bayer Crop Science, Du Pont Dow and BSF Plant Science)control practically the entire research and output in the fields of transgenic processes and products, including research methodologies are patented and farmers has no control on the means of production with the development of new varieties.[1]

Mangla Rai and B.Prasnna (2000) also came to the same conclusion and put forwarded that an important difference between 'green revolution' and 'gene revolution' is regarding the patenting of processes as well as products.[2] The main process behind the green revolution was conventional plant breeding technology, which has been well established and exploited by public sector institutions. Access to genetic resources and improved cultivars, or even the methodology was not an issue .Today, the processes and key components used in modern agricultural biotechnology are increasingly subjected to Intellectual Property Rights (IPR) Protection along with the products and results.[3]

Dayanath Jha*(2001-03) also favoured technological change in agriculture and revealed that technological change has emerged as a powerful source of growth .The green revolution illustrated it dramatically. Even poor producer were able to internalize

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[1] Sahai, Suman (2004)
[2] A new era of both product and process patent is originated with new Patent Amendment Act.
[3] Mangla Rai and B.Prasnna (2000)

its production and benefits to improve their incomes and food security. Poverty level in rural area declined and country moved from food deficit to food surplus in two decades.[4]

Ronald J. Herring (2004) argued that the genomics revolution created potential, but contested, economic value in biodiversity per se. Herring also emphasized that public goods are at stake due to this new revolution.[5]

Many see the new transgenic technologies as a great opportunity to enhance productivity and concomitantly increase the sustainability of agriculture. Many opponents see it as a dangerous tool of science and technology which has implication for human health, biodiversity and sustainable development and well being of small farmers.[6]

Some others on the basis of north-south divide also argued that northern countries are gene poor while those are in the south gene rich. The north is technology rich while the south is technology poor. The green revolution and current technology widened this gap. But there is also a counter argument that new technology may bridge this gap by effective enhancement of capabilities of gene rich and technology poor segment by the effective utilization of modern tools of science and technology like gene mapping, tissue culture and genetic engineering .Most of the scientist from developing world are also in favour of adoption of new genomics for maintaining food security of the developing world. They have positive argument that, if quality specific traits of genes from traditional biowealth are incorporated into new crop varieties then it will give economic benefit to both the actors that is gene provider and gene user due to benefit sharing concept of new IPR regime.

Technology like transgenic seed and verminator technology is often debated with several facts and figures and assumption. Some have opposite argument some have positive thoughts. Schell(1993),Casper and landsman(1993)young (1994) said that genetic engineering is based on the transfer of 'defined genes ' and considerable amount of data available from field tests with transgenic plants demonstrate that no risk are

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[4] Jha (2001-2003.)
*ICAR, National Professor, National Centre for Agricultural Economics and Policy Research.
[5]Herring Ronald J (2004)
[6] Grover, Anil and Pental Deepak; 'In this Issue' Current Science, Vol.84.No.3.10 February 2003.

involved in releasing transgenic. However, critics of transgenic technology refuted the statement.[7]

Regal (1994) asserted that the mechanism and potential of conventional selective engineering and genetic engineering can be profoundly different. Although this does not mean that every transgenic is ecologically dangerous, some transgenic may be considered riskier than what could be produced with selective breeding, especially when an ecologically competitive host is supplemented with noble feature that may increase its competitiveness.[8]

Some has also negative argument about green revolution. Gordon Conway (1997) stated that the high yielding technology that heralded the green revolution has, no doubt, rescued the country from chronic food deficiency and starvation but it has its adverse effect too. The high input cultivation of rice and wheat has led to excessive water use and eroded soil quality; indiscriminate use of chemical pesticide has led to pesticide resistance making pest management increasingly difficult.[9]

The concept of doubly green revolution was first put forward by the former head of the Rockefeller foundation, Gordon Conway, in 1997 by that name. Dr. Conway argued that the world needed a doubly green revolution that would be even more productive than the first green revolution and? Doubly green? By conserving natural resources and protecting the environment.[10] Dr. Cantrell added that modern technologies can be environmental sensitive if they are designed and used with the benefit of modern ecological knowledge.[11]

In a report on transgenic plants and world agriculture prepared under the auspices of the royal society of London, science academies of US, Brazil, Mexico, china, INSA, TWAS ,it is said : "we conclude that steps must be taken to meet the urgent need for sustainable practice in world agriculture if the demands of an expanding world

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[7] Schell(1993),Casper and Landsman(1993)Young (1994)
[8] Regal(1994)
[9] Conway Gordon ,The doubly green revolution: food for all in the 21st century ,Penguin,London,1997,p.334
[10] IRRI press release October 29, 2004 Asia New Rice Revolution
[11] ibid

population are to be met without destroying the environment or natural resources base. In particular, GM technology coupled with important development in other areas should be used to increase the production of main food staples, improve the efficiency of production, reduce the environmental impact of agriculture, and provide access to food for small farmers".[12]

V.R Gadwall (2003) has projected that alternative technology as a solution for the problems which can't be solved by traditional breeding approach.[13]

Plant breeders can rectify problems only when there is variability available for the desired characters within the compatible species complex. Transfer of useful trait from distantly related species which do not sexually cross with the crop plant is not possible through conventional recombination breeding procedure. considering that many problems still remain unsolved and that the currently available technologies are inadequate to solve them, there is need for alternate technologies .recombinant DNA technology that enables movement of genes of interest across sexual incompatibility barriers is one approach plant scientist are relaying upon worldwide today to find genetic solution to specific problems[14].

2.2. Traditional Knowledge, Biodiversity and Intellectual Property Rights

Seed is the basic input of agriculture on which whole agricultural operation, innovation and development is based. Seed plays a central role in agriculture-society-environmental interface. In the new IPR regime seed provide a debate between traditional knowledge and modern technological breakthrough. Bradford and Cohn (1998) stated that "seeds are the connection between the past and future. They contain the accumulated genetic wisdom of the past, and the potential for its perpetuation in the future".[15] This is the traditional knowledge system that saved the seeds for present generation and this is

[12] Sharma, Manju (October 17,2003) First Foundation Day Lecture on Regulatory Measure for Utilizing Biotechnological Developments in Different Countries
[13]Gadwall V .R,(2003)
[14]Paroda R.S.
[15] Bradford, K. J. and Cohn, M. A.(1998)

the modern emerging technology that will make its propagation and distribution more convenient for the human welfare and again for the coming generation.

One group of thinkers argued that the south Asian region is the one of the larges gene rich regions of the world and equally rich in traditional and indigenous knowledge .the rich socio-cultural heritage of the developing countries is evident in that the plant variety has always remained freely accessible to all since times immemorial.

Sharma (2000) argued that the Asia–pacific region is rich in agro-biodiversity. It is the centre of origin of several important crops including rice, sugarcane, coconut, jute and cotton, besides vegetables and other crops. The region has a gene pool for several plant species that have already been identified as 'endangered'. With more than 47000 species of plants and two hot –spots of biodiversity, 8 % of the total biodiversity is available in the Indian sub-continent.[16]

R. A. Mashelkar (1999) revealed that the issue of economics based on traditional knowledge and biodiversity is far more complex. India, with approximately 8% of the worlds biodiversity and as one of the greatest storehouse of traditional knowledge have a potential of becoming a major player in global trade in herb based formulation, medicine and products. An estimate by the EXIM bank puts the international market of medicinal plants related trades at US $60 Billion per year growing at about 7% annually. India has only 2.5%share of the market.[17]

Anil k Gupta (2003) also emphasized that traditional knowledge system help a very large section of our society not only survive against all odds but also generate in the process, some of the products, which might have national and global market if properly developed.[18]

[16] Sharma(2000)
[17] Mashelkar, R. A.(1999)
[18] Gupta , Anil K (2003)

Fred Powledge (1995) asserted that Rice and beans, wheat and soybeans were part of the global commons, along with air, soil, water.[19]

Elenita C Dano argued that more than 70 % of worlds biodiversity are found in only 7 % of the earths surface, namely in key centres of mega-diversity spread across Asia, Latin America and Africa.[20]

Anup Shah argued that large trans national corporation like Monsanto, Du Pont and others have been investing into biotechnology in such a way that patents have been taken out as indigenous patents which have been used for generation by the local people ,without their knowledge or consent.[21]

UNCTD –ICSTD project on IPRS and sustainable development also came to conclusion that TK is being widely disseminated and commercially exploited, with only a small proportion of the benefits flowing back to provider peoples and communities, raises the question of ownership. This project report also raised an important question who owns TK, according to traditional people and communities? And who owns, according to most national legal systems and the international IPR regime.[22]

Vandana Shiva argued that the expansion of new "IPR" into the domain of life forms and biodiversity, and globalization of this regime TRIPS of GATT/WTO ,has been an attempt to enclose the biological and intellectual commons.[23]

Muchkund Dubey (2005) stated that the provisions in the TRIPS agreement FOR the patenting of plant varieties, micro-organisms and micro-biological processes[article 27.3(b)] can be potentially used by multinational companies for the piracy of the bio-resources and related traditional knowledge ,from developing countries .he quoted the example of basmati rice, neem ,haldi, etc. He also predicted about another discriminatory aspects of the TRIPS Agreement is that it provides for higher level of protection to GI relating to wines and spirits ,in which developed countries alone have interest. South Asia

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[19] Powledge, Fred(1995) Bioscience.Vol.45.No.7 (Jul-Aug.,1995)pp440-444
[20] Dano ,Elenita.C
[21] Shah ,Anup
[22] UNCTD-ICTSD project on IPRs and Sustainable Development. page 117
[23] Shiva ,Vandana

has many GIs of tremendous commercial value such as jamdani, basmati rice, Darjeeling tea, kolhapuri chappals etc., for which such protection is not available.[24]

2.3. Impact of New Technology and IPR on Agricultural R & D

Due to adoption of TRIPS under WTO obligation, the research and development pattern in agriculture has affected by several dimensions. Liberalization, globalization and free market access system have several impacts on Indian agricultural research and development and food security. Agricultural R & D in the India owes its origin as well as present status to public sector. After enactment of WTO and new seed policy in year 1988 ,several changes has occurred and still occurring like emergence of private sector, multinational corporate and company merger in agricultural sector.

Pal and Bayerlee (2003) analysed the historical perspective of research and development in agriculture and told that "nearly 30 years ago, a global consensus emerged that developing countries must target 1-2 % of agricultural GDP for agricultural research and that the government must lead this in view of the very limited private sector presence". They also revealed that the economic reforms of last 10-15 years encouraged private sector participation in agricultural research and development.[25]

Jha (2003) accepted the changing pattern of market demand in agricultural research and came to conclusion that economic liberalization and integration with the global market has change this basic premises ,economic efficiency has became the new mantra and regional and global comparative advantages is the new route to future agricultural and economic growth. This will demand major adjustments in resource allocation and production patterns.[26]

Malik and Jafar (2005) revealed that with structural adjustment and liberalization, public research institutions are under pressure to become involved in income generating activities. Revenues from licensing or royalties, or from provision of services, could

[24] Dubey Muchkund(2005)
[25] Pal and Bayerlee (2003)
[26] Jha (2003)

therefore become important for those institutions, which until; now have made their "innovation" freely available to both public and private sector. The need for public sector research in agriculture will remain despite the private sector assuming a growing role .They also emphasized that the introduction of IPR system may even facilitate a more rational public /private division of biosecurity roles.[27]

Harbir Singh (2002) analysed that more proprietary controls in research tools and uncertainty in the limits of ownership make the conduct of agricultural research all the more difficult by requiring complicated negotiations. He asserted with example of use of golden rice variety involves clarifying user license for over 70 patents.[28]

2.4. IPR, Biotechnology and Biosecurity

Post 1990 has witnessed several changes in global trade in all aspects like manufacture, services and agriculture due to WTO enactment. In case of developing world particularly India several new terms appeared simultaneously like IPR, Biotechnology in agriculture, Biosecurity. There is a little doubt that the breakthroughs in biotechnology, genomics and genetics will affect our societies and many vital corners of human life as efficiently and effectively as information technology did.

Some are very doubtful about new scenario and some have very positive argument in favour of these. There is a counter argument for them, who only raising slogan against the new technology and projecting it as a tools of biopiracy. Malik and Jafar (2005) strongly argued that biodiversity and genomics will be the source not only of tremendous amounts of biological materials, from large organism to miniature genes but also a source of data that will be a key to R & D in the life science for crop biosecurity.[29]

Lesser (1997) argued that by means of new technology biological materials and data have long been preserved in and disseminated by repositories of microbial culture

[27] Malik ans Jafar(2005)
[28] Singh ,Harbir (2002)

[29] Malik and Jafar (2005)

collections, and seed banks. These biological collections face great challenges and great opportunities owing to the explosive increase in biological materials and data.[30]

It is argued that IPR in general and patent in particular have played and continue to play a pivotal role in the rise, the development and application of the modern biotechnology. More recently it has also been generally accepted that the patent system is well suited to be utilized as the primary mechanism for transferring invention from publicly funded institution to the private sector. Licensing of patents held on publicly funded research thus enhances wide application of the protected technology in industry and commerce and at the same time secure additional financial means for the technology-generating institutions.[31]

2.5. IPR and Food Security

There are different thoughts in counter groups about issues of the food security in the new IPR regime. Various institutional changes occurred in respect of IPR and food security. The tools of IPR like patenting, plant variety protection and geographical indication with emerging technology often debated in counteracting forces with opposite argument in context to food security. One group of thinkers often claimed that the new tools will hamper food security of the third world by monopolization, commodification and commercialization of resources by new legal and more protective instruments. The counter argument is that new tools will create economic incentives for scientific community that will promote them to do some greater innovation for public welfare.

N.R. Subbaram (2001) has very positive argument about the impact of new patent amendment act and PVPFR act on food security. He stated that the legislation relating to the protection for the new plant varieties is expected to be advantageous to India particularly in the area of food. This is because such legislation will encourage development of new varieties of plants, which are useful in the area of food and also to

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[30] Lesser (1997)

[31] First International Conference on Intellectual Property and Technology Transfer in Life Science, A North-South Dialogue, 12th-14th June 2006,Trieste

protect such new plant varieties to safeguard the interest. Such an environment will have great impact in the production of food, which will result in the availability of food items in abundance, facilitating its availability at reasonable rates.[32]

Kumar et al (2003) stated that there is evidence that with respect to the vanguard crops-rice and wheat-in leading regions of north-western India, there is indeed a deceleration. New challenges have emerged even as traditional concern of sustained food security permits no room for complacency. Poverty and hunger, despite significant improvement, are still serious challenge.[33]

Vandana Shiva (2002) stated that patent on seeds affect food security by forcing farmers to pay royalties for seeds, thus increasing the cost of production ,and hence ,the prices of food.[34]

One group of thinker realized that the new tools of technology and IPR as a threat to food security. They asserted that the private sector, particularly a few MNCs, have invested heavily in bio-technology. As a result, a significant part of the unfolding bio-revolution is likely to come from the private sector. The private seed sector needs returns on its investment, which can be ensured mainly through patenting of its products, unless the government wants to compensate it through lump sump transfers. This act has at least two implications with respect to food security, first is the relative increase in prices of seed in comparison to publicly funded research and second factor is that the oligopolosiation of seed market by terminator seed technology.

William lesser (1987) has a comprehensive approach and stated that overall seed patents are anticipated to provide moderate private and social benefits at moderate costs especially if public seed breeding remains a competitive force in the industry.[35]

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[32]Subbaram, N. R (2001)
[33] Kumar et al (2003)
[34] Shiva, Vandana (2002)
[35] Lesser, William (1987)

Chapter – III

History and Economics of Rice Cultivation and Issues of Emerging Technologies in Rice Research

3.1. Role of Rice in the Indian Economy

Rice is the staple food of more than 60%of the world's population.[1]This is the largest food source for the poor, providing 50 to 80% of daily calories intake.[2] This crop provides food and nutritional security to the masses of Asian subcontinent. Rice is the most important cereal grown over an area of about 43 M. Ha with an irrigation facility to cover 43 % of total area.[3]This is the staple food and principle crop in most of the developing nation. From the Philippines in the east to eastern India in the west, from central and southern China in the north to Indonesia in the south, rice accounts for between 30 and 50 % of agricultural production and between 50 and 80% of dietary intake.[4]

Because of its importance in providing national food security and generating employment and livelihood from nursery stage to post harvest management for resources poor farmer, most of them belongs to downtrodden classes of society, most developing nation's governments like India regards rice as a strategic, political and social commodity. In India rice is the major cereal crops which contribute in food grain basket of the country.

The major food grain production and contribution of rice in food grain basket is tabulated below:

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[1] Singh, Chidha(1997)

[2] Kenneth S. Fisher, John Burton, Gurdev S. Khush ,Hei Lung ,Ronald Control, Collaboration in Rice, Science Compass Policy Forum science,vol.290 13 October 2000.

[3] Singh, S.S (1998). Rice , Crop Management, Under Irrigated and Rainfed Condition, Kalyani Publishers, New Delhi .pp 58-93.

[4]Hossain, M S Fisher,K.S.1995.Rice Research For Food Security and Sustainable Development in Asia :Achievement and Future Challenge,Geojournal,35(3) :286-298

Table 3.1. Food Grain Production in India

Crop/year	2000-01	2001-02	2002-03	2003-04	2004-05*	2005-06$
Rice	85.0	93.3	71.8	88.3	85.3	73.8
Wheat	69.7	72.8	65.8	72.1	72.0	----
Coarse Cereals	31.1	33.4	26.1	38.1	33.9	26.4
Pulses	11.1	13.4	11.1	14.9	13.4	5.0
Food Grain						
Kharif	102.1	112.1	87.2	116.9	103.3	105.3
Rabi	94.7	100.8	87.6	96.6	101.3	---
Total Kharif and Rabi	196.8	212.9	174.8	213.5	204.6	

Source: Ministry of Agriculture

*4th Advance Estimates & 1st Advance estimates (kharif only)

Maintaining self sufficiency of rice production and ensuring stability in rice market prices have remained political objective in most Asian countries. Over 90% of the world rice is produced and consumed in Asia. It is the second most important crop of the world and is grown annually on 151M.Ha with an annual production of 593 Million Tones (MT) and average productivity of 3.91 Tones/Hectare.[5]

This crop is also important for its nature of cultivation. It is argued that Indian agricultural economy is based on monsoon and rice is the crop which depends on monsoon for its production due to its large consumption of water. Therefore, it is

[5] Rai, Mangla; Secretary DARE and DG ,ICAR, New Delhi ,India Genetic Diversity in Rice Production :Past Contribution and the Potential of Utilization for Sustainable Rice Production ;FAO Document repository . website assessed on 13/5/2006.

suggested that Indian food security and food economy is based on rice production and management. Rice is also a very politically sensitive crop because the agrarian economy of green revolution areas notably, Punjab. Haryana and Western U.P are totally based on this crop. Each and every year one may witness the issue of Minimum Support Price (MSP) raised by farmers lobby of Haryana and Punjab for stacking their claims for increasing MSP.

Rice is the crop of monsoon Asia having hot and humid climate. Traditionally, it was grown in well watered river valleys and deltas. However, with the advent of new irrigation technology it is now grown even on upland and dry areas. This is also a labour intensive crop. Most of the farming operation is done manually due to lack of technology for our resources poor farmers. Uprooting the seedling from nursery, transplanting them in flooded and well puddle soil, removing weed from field at certain time interval and harvesting require a lot of manpower. After harvesting, it requires a lot of manpower and investment in post harvest operations like drying and milling of rice. It is argued that it has a great role in the maintenance of socio-economic stability of world's developing countries.

It is staple food of humid areas of Assam, Manipur, West Bengal, Orissa, Bihar, Eastern U.P. and South India. It prefers low lying and water logged areas, where none of other cereals could be grown. However, with the advent of tools of science and technological inputs like improved varieties and plant types has made it possible to grow rice in those areas which have relatively low rainfall and lighter soil types like Punjab, Haryana and Western U.P and it has been found that yield in newly acquired areas is much higher than the traditional rice growing areas which could be accounted for evolution of high yielding dwarf plant types, better soil and water management practices and efficient nutrient management etc. which may be seen as the impact of green revolution on Indian agriculture. The green revolution belt of India notably Punjab and Haryana also provides an example of paradoxical situation because people of these states are habituated to feed wheat products but the farmer used to grow rice for the economic purposes or benefits.

The importance of rice for Asia has been well recognized in the literature. Asian produce and consume approximately 90 % of the world rice .There per capita annual consumption is around 100 kg compared with 3-4 kg in western world.[6] Rice is the staple food of most of the Asian countries like Bangladesh, India, Myanmar, The People Republic of China, Indonesia, Japan, South Korea, Malaysia, Nepal, Philippines, Singapore, Sri Lanka, Thailand and Taiwan[7]. Total rice production and consumption in these countries accounts for 85% of world consumption and production.

Among the Asian continents, India has the largest area under rice cultivations and ranks second in production just after the china, but, it is country listed with the lowest yielding countries. Of the 414 rice growing districts, close to 70 % are with yields lower than national average.[8] The yield gap in context to regional, national and international level is remarkable concern for scientist, social scientist, economist and policy makers. Even by moderate estimates, the yield level of rice has to increase by 25-30% from the present level of 1.91tones/hectare if the country is to remain self sufficient by 2010.[9]Given the biophysical opportunities and unfolding technological advances, achievement of such high target should not be difficult. In the wake of fast eroding natural resources bases, the challenging task however would be to ensure the production growth at around 2.3% annually on a sustainable basis.[10] Sustainability assumes relevance when the ongoing R&D efforts are for the progressive yield increase areas across ecology .Vertical growth being the only option to sustain the current level of self sufficiency and to maintain the food and nutritional security of the nations.

It is argued that development of new varieties suitable for different rice ecology is the only option for the fulfilment of food and nutritional requirement of the masses. Government of India is also taking efforts to inquire into issues to identify the areas and ecologies on the basis of productivity status, factor productivity trend and output/input

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[6] Shochi Ito,. Wesley .Peterson and warren R Grant (1978) Rice in Asia: Is It Becoming as Inferior Good. American Agricultural Economics Research Association 1978 p 39-41.
[7] Ibid p 39
[8] Siddiq, E.A.(2000),Rice: Yawning Productivity Gaps .Survey of Indian Agriculture 2000,The Hindu.pp39-44
[9] ibid p39
[10] ibid p 39

ratio for appropriate research, development and policy interventions. India has achieved self–sufficiency in food during the past decade and the country must now increase food production by at least 5 Million Tonnes and rice by 2 Million Tonnes every year to sustain this self sufficiency but the option available to accomplish this task are very limited.[11]

To increase production and productivity in the country, innovative science and technological innovations are required like new plant type concept and new biotechnological tools to increase potential yields and yield heterosis in hybrid rice. It is favoured by our most of scientist to adopt hybrid rice technology to satisfy our needs, which is supported by china's hybrid rice success. Hybrid rice helped to china to increase rice production from 129 MT to 200 MT annually. India has witnessed agricultural transformation due to adoption of high input technology but challenge to feed our masses is still a socio economic as well as political concern because green revolution shown its plateau stage and adoption of the new technology like biotechnology and genomics seems to be only option to maintain the social and economic stability of the nation.

The slogan "rice is life" is most appropriate for India as this crop plays a vital role in national food security and means of livelihood for millions of rural households. India has the largest acreage under rice (44.6m ha) and with a production of 90 MT During the period 1950-51 to 2001-2002 the area has increased by 1.5 times (30MHa to 44.6MHa), productivity by 3 times (668 Kg /Ha to 2086Kg/Ha) and production by 4.5 times (20.58 MT to 90 MT).[12] This spectacular transformation in agriculture has helped the country not only to become self sufficient but also to have buffers stocks in godowns of FCI and exportable surplus. On the basis of market surplus of this crop, Food Corporation of India is playing its role from 1965 to till this date to maintaining national food security. But India should not be complacent with the present buffer stock as it indicates only physical accessibility on account of lack of purchasing power of the people below poverty line whose number more than 260 million(26%of the population).

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[11] Attavar, Manmohan (2000); Hybrid Rice: Bright prospects ahead, The Hindu Survey of Indian Agriculture 2000.pp45-47.

[12] Mishra, B(2005);Rice 'More crop per drop' The Hindu survey of Indian Agriculture 2005 pp41-46

Rice is also an important exportable commodity from India. In the international market rice is traded into two categories namely fragrant and non-fragrant rice. Basmati rice is most preferred fragrant rice in world. India dominates this trade and followed by Pakistan. In recent years India has also started exporting non basmati rice. India annually produces 6-10 lakhs tones of basmati rice, more than 70 % of which is exported.[13]After marine products, rice is the single largest commodity exported from India. The role of rice in India's export is illustrated below in the table 3.2.

Table 3.2. Agricultural Export

Items	2003-04		2004-05		2004-05*		2005-06*	
	Millions US Dollars	% Share of Agri Export	Millions US Dollars	% Share of Agri Export	Millions US Dollars	% Share of Agri Export	Millions US Dollars	% Share of Agri Export
Rice	907.1	12.0	1478.2	18.5	592.6	14.2	936.6	19.2
Agricultural Export	7532.00	100	8001.17	100	4181.4	100	4885.5	100
Total Export	63049.00		78205.3		42132.2		51114.4	
Agri Export as % of Total Export		11.9		10.2		9.9		9.6

Source: Department of Commerce (DGCI & S) Page No.172, Agriculture, Economic Survey (2005-06)

*April –October

[13] Compiled from Multi Commodity Exchange of India Limited.

At the current rate of population growth, rice production has to be enhanced to about 125 MT by 2020.Achiving this projected target is a big issue as this increase has to be attained with shrinking land and water resources, scare and costly labour and other inputs and degrading environment. Therefore, rice farming and whole rice sector have to be reoriented to face the future challenge and the farmers have to change their mindset also to turn rice into a lucrative economic product rather than a single food commodity.

"Rice is a high energy or high calorific food of the poor. It contains 6 -7%of protein and biological value of its protein is very high due to essential amino acids contents. It has low fat content ranging 2-3%, much of which is lost during milling process. By-products of rice milling are used for a number of purposes like rice bran which is used as cattle and poultry feed .Rice husk can be used for the manufacture of insulation material, cement and cardboard and are also used as litter in poultry keeping."[14]

3.2 Origin and History of the Crop

The cultivation of the crop probably dates back to the antiquity and has probably been the staple food and the first cultivated crop in Asia. Excavation from Non Nok Tha in Thailand had yielded carbonized rice glumes, probably dating back to 3500 B.C. or earlier.[15] The carbonized grains obtained in India could be dated around 2300 B.C.[16] The Asian rice evolved from the ancestral wild progenitor over a broad region stretching from the Gangetic plains below the Himalayan foothill areas across NE-India, Upper Burma, Northern Thailand, Laos, Vietnam and South China. It is generally argued that the domestication had occurred independently, and India is the one of the oldest regions where domestication began.

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[14] Singh, Chidha(1997) Rice (*oryza sativa* L). Modern Techniques of Raising Field Crops. Oxford New Delhi and IBH Publishing Company Pvt.Ltd.pp1-40

[15] Field Crops,Cereals,Rice; Hand Book of Agriculture(Facts and Figures for Farmers, Students and all Integrated in Farming) ICAR Publication (2002)pp760-789

[16] ibid p760

Carbonized paddy grains were found in the excavation at Hastinapur (UP) at a site dated between 1000 to 750 B.C.[17] It is claimed with the proof that this is the oldest rice specimen yet known in the world. From study of Sanskrit and other different vernacular languages in the South-Eastern Asia, many investigators have come to the conclusion that rice was known in India before the present time.

De Candolle (1886) and Watt (1892) thought that south India was the place where cultivated rice originated. N. I. Vavilov (1926) suggested that India and Burma should be regarded as centre of diversity of cultivated rice.[18]

Historian following rice cultivation and evolution record that it is the Asia region, more particularly the Korat region of Thailand, the longitudinal valleys of Myanmar,S-W china and Assam ,that domesticated rice in early times. *Oryza fatua* is recorded as one of the early rice species that was recorded from the farmlands. Rice is the perhaps the only grain that fed more people in history than any other crop.[19]

Rice belongs to genus 'oryza' of 'gramineae' family. The genus 'oryza' includes, 24 species, of which 22 are wild and two namely '*oryza sativ*a' and '*oryza glaberrima*' are cultivated. All the varieties found in Asia, America and Europe belong to 'o. sativa' and varieties found in West Africa belong to species '*o. glaberrima*'.[20]

3.3. Genetic Diversity in Rice: Wild Rice Genetic Resources and Traditional Varieties

Agriculture in developing world depends mainly on genetic diversity of crop. Agriculture is started more than 10000 years ago, from this date domestication and cultivation of crop started based on the inherent genetic bio-wealth of our traditional agricultural practioners and mode of preservation of crop genetic resources. It is

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[17] Singh, Chidha (1997) Rice (*oryza sativa* L) Modern Techniques of Raising Field Crops. Oxford New Delhi and IBH PUBLISHING company Pvt.Ltd.pp1-40

[18] Chidha Singh (1997) Rice (*oryza sativa* L). Modern Techniques of Raising Field Crops. Oxford New Delhi and IBH Publishing Company Pvt.Ltd.pp1-40

[19] Pisupati, Balakrishna (2005) Rice Research in Asia: An Introduction. Asian Biotechnology and Development Review pp1-7

[20] Duncan A. Vaughan and Lesley A. Sitch(1991) Gene Flow From the Jungles to Farmers, Wild Rice Genetic Resources and Their Use, Bioscience Vol.41.No.1.January 1991

estimated that not even 15 % of genetic diversity has been utilized in nearly all crop plants.[21] It is also estimated that 70 % of worlds biodiversity is concentrated in 12 biodiversity rich nations namely china, Brazil, India, Indonesia, Costa Rica, Colombia, Kenya ,Peru, Venezuela, and south Africa.[22]The centre of biodiversity of different crops is tabulated below:

Table 3.3. Centre of Origin of Crops

Sl. No.	Centre of origin	Crops
1	Southwest Asia (fertile crescent)	Cereals, Legumes (Peas, Lentil, Barley) and Diploid Cotton
2	Africa	Barley,Emmer,Flax,Chickpea,Pea,Lentil,Lettuce,Onion,Fig,Grapes,Olive ,Millets,Sorghum,African
3	China and south east Asia	Millets ,Vegetables ,Soybeans ,Rice ,Citrus ,Tea ,Bananas ,Mangoes ,Coconut, Sugarcane
4	America (Mexico, south America)	Maize, Potatoes, Sweet Potato, Bean, Tomato, Chilli Pepper, Peanut, Bottle Gourds, Cucurbits, Sunflower, Cotton ,Sweet Potato,Pineapple,Papaya,Avocado,Tobacco,Cassava,Cacao,Vanilla,Cash ew,Pecan,Brazilnut,Coca.

Source: World Atlas of Biodiversity, UNEP World Conservation Monitoring Centre, USA 2002.

Rice has different types of genetic stocks suitable for different agro-climatic condition. The wild varieties also show the scientific theory of adaptation and natural selection.[23] Most of the high yielding varieties developed on the basis of existing varieties or traditional varieties of the crop, which is preserved and provided by traditional farmers and tribal communities. It is estimated that India accounts for approximately 8 % of biodiversity of crop.

[21] Genetic Diversity in Rice. FAO Document Repository assessed on 13/5/2006.
[22] Singh, Harbir(2002)Emerging Plant Variety Legislation and Their Implications for Developing Countries:Experiences from India and AFRICA. Paper Presented in the National Conference on TRIPS – Next Agenda for developing countries , Shyamaprasad Institute for Social Services,Hyderabad,11-12 October 2002.
[23] Theory of Natural Selection is put forwarded by Charles Darwin.

Wild relatives of rice are important source for further innovation and development of new varieties. The survival of wild relatives of rice in natural habitats over millennia, their in built resistance to adverse condition ,and their adaptation to diverse ecosystem can provide insight relevant to a more sustainable and productive agriculture.[24] There is also counter argument that wild relatives of rice are not a panacea for all the problems limiting rice production because they can be alternate hosts for insect, pest and pathogens.[25] The international rice germplasm centre (IRGC) at the international rice research institute (IRRI) conserves approximately 85000 samples of rice germplasm in which only 2 % are of wild relative of rice.[26]

Both 'ex situ' or 'in situ' conservation of wild rice genetic resources is demand of our time to study about different inherent and inbuilt traits for development of new plant type of rice. Following table represents the sites where in situ conservation of wild rice germplasm is done.

Table 3.4. Sites Where Wild Rice Germplasm is conserved in situ

Country	**Conserved area**	**Species of rice**
India	Parambikulam Game Reserve ,Kerela	O. rufipogon O. officianalis O. granulata
	Karulai Range Teak Plantation /Forrest Reserve Kerela	O. nivara O.granulata.
Thailand	Pukae Botanic Garden; Mae Sai valley Forrest Reserve and Botanical Garden near Chaing Mai	O.granulata
	Khao Sam Lam National Park	O. officianlis O.. ridleyi
Sri Lanka	Yala Strict Natural Reserve	O. nivara O. rhizomatis
	Ruhuna National Park	O. nivara O. rhizomatis
Indonesia	Ujung kulon National Park	O. officinalis

Source- Duncan A.Vaughan and Lesley A. Sitch (1991) Gene Flow from Jungle to Farmers, wild – Rice Genetic Resources and their Uses. Bioscience,vol.41.No.1. p26.

[24] Duncan A.Vaughan and Lesley A. Sitch (1991) Gene Flow from Jungle to Farmers, wild –Rice Genetic Resources and their Uses. Bioscience vol.41.No.1. pp22-28.
[25] Ibid p22
[26]Ibid p22

It is argued that the conserved germplasm in gene banks and in situ provides the building block for programmes now underway that are designed to transfer from many wild species a range of traits, some of which are absent in cultivated rice. It is also argued that biotechnology may offer methods that will increase the range of wild species suitable as donors and methods that will make gene transfer from these species more efficient. By using diverse source of germplasm in breeding programmes, improved varieties for farmers will have different genetic backgrounds, reducing the problems that can result from genetic uniformity.[27]Most of the Asian rice growing countries has shown genetic uniformity in case of rice cultivation due to adoption of a particular variety or germplasm or lines. The genetic uniformity in rice crop is presented in following table:

Table 3.5. Extant of Genetic Similarity in Cultivated Varieties of Rice in Selected Asian Countries

SL NO.	Country	Extant of Uniformity
1	Tropical Asia	95 % of HYV based on single dwarfing gene Sd1
2	China	95% of the hybrids based on single sources CMS(WA)
3	Bangladesh	62%descended from common stock
4	Indonesia	74 % descended from common stock and ^50% of rice under 3 varieties
5	Sri Lanka	75% descended from common stock
6	Myanmar	75 % rice under 3 varieties
7	Malaysia	70% area under one variety(MR84)
8	Japan	More than 70% area under 3 varieties
9	Taiwan	81% descended from common stock and 82% rice under 3 varieties
10	Thailand	50% area under two varieties.

Source-Genetic Diversity in Rice, FAO Document Repository, assessed on 13/5/2006

[27] ibid page 28.

Traditional varieties of rice also provide scope for the reorientation of thinking about science and tradition. V. Arunachalm (2001) asserted tradition is a term intimately associated with biodiversity. It is acknowledged that the tribal farmers of India are gene rich but resources poor. Their invaluable genetic resources, including land races and local varieties carry novel genes controlling important nutrients, cooking quality and resistant to different biotic stresses. However, a survey of tribal areas suggested that there is sufficient scope for fine tune tribal indigenous knowledge (IK) for optimizing benefits.[28]

In context to rice breeding if scientific knowledge is synergized with TK it may likely to have some positive impact. India and Pakistan are together providing 'Basmati rice' till this date to world community. Basmati is one of the most important exportable good from both the countries. But, Indian rice genetic diversity has several other aromatic traditional varieties, which are qualitatively different from basmati in this respect. The traditional rice varieties of rice are tabulated below:-

Table 3.6. Traditional Aromatic Varieties of Rice

Sl. No.	State	Traditional Aromatic Varieties
1.	Andhra Pradesh	Amritsari, Sukhdas and Kaki Rekhalu
2.	Assam	Badshabhog and Prasadbhog
3.	Bihar	Badshabhog, Ram tulsi, Tulsi majri
4.	Jammu and Kashmir	Muskhbudji
5.	Kerela	Jeeraksala and ghondhaksala
6.	Madhya Pradesh	Dubraj, Adamchini, Badshabhog
7.	Chatishgarh	Kalimooch, Chattri and Kalikamod
8.	Mharastra	Ambemohar, Pankhrai and kamodjirsal
9.	Orrisa	Kalajeera, Badshabhog and Manakchanda
1o.	Uttar Pradesh	Adamchini, Badshabhog, Badsahpasand, Duniapet, Kartaribhog, Hansraj, Ranguni Pagal, Ramajuvain, Sakharchini, kanakjeera, kalanamk and Tilakchandran.

Source: complied from Trends in Rice Trade and New opportunities with Traditional Speciality Rice:Rice India.p85-90

[28] V .Arunachalm (2001) The Science behind Tradition ,Current Science, vol.80,No.10 25 May 2001 pp1272-1275.

There is archaeological evidences that rice was cultivated in India between 1500 and 1000B.C.with its long history of cultivation and selection under diverse agro ecology, rice adopted into different climatic and soil conditions ranging from deep water to swamps, irrigated to dry land and saline alkaline to acidic soils. It is argued that with scientific facts it may be grown under diverse geographical, climatic and cultural condition.[29] The diversity of this crop can not be quantized, but it is estimated that it has around 1,40, 000 different genotypes. The IRRI gene bank preserves nearly 100000 accessions. India alone has 86,330 accessions, of which 42,004 are in the national gene bank, which is enriched by further explorations, collection and conservation.[30] Sociological tradition have increased the diversity of Indian rice in terms of morphological and quality traits, especially grain size, shape and colour, as well as aroma and endosperm properties.[31]

Ancient Aryuvedic literature (Indian material media) from the 15th and 16th century A.D. describes different rices, particularly scented varieties with medicinal and curative purposes. As far back as 400 B.C., Susruta, the great Indian pioneer in medicine, described the medicinal properties of rice.[32]India has the largest collection of rice genetic resources confined mainly in Jeypore tract of Orrisa and Raipur collection in Chatishgarh. The Indira Gandhi Krishi Vishyavidyalya (IGKV) collection of rice germplasm, the largest such in India and second largest in the worlds includes the' indica' rice varieties that originated from Chatishgarh. These include those with varying durational varieties (from 60 days to 150 days); the largest (Dokra-Dokri),the longest and the shortest rice varieties: some varieties that can grow under 1o feet (3 meters) of water (Naatragoidi);those with high protein content and medicinal properties ; and scented rice varieties.[33] The tribal belt comprising parts of Chatishgarh, Madhya Pradesh and Orrisa

[29] Genetic diversity in rice :FAO document repository assessed on 13/5/2006
[30] ibid
[31]Bala Ravi .S: Trends in Rice Trade and New opportunities with Traditional Specialty Rice.RICE INDIA
[32]Genetic diversity in rice: FAO document repository assessed on 13/5/2006
[33] Krishna Kumar, Asha;Genetic Resources: Rice and Rights. http://www.flonet.com assessed on 13/2/2006

including Jeypore tract is rich in rice varieties as well as traditional knowledge associated with their use.[34]

3.4. History of Rice Breeding

The breeding of high yielding semi dwarf varieties of rice and their adoption by farmers made green revolution a real dream for Asian countries. Potential food shortages in third world were alarming in the mid 1960s.Paddock and Paddock (1967) predicted that the 1970 would be a "time of famines," and classified India and Egypt as countries that were beyond saving.[35] But improved rice and wheat varieties and the accompanying technology averted the predicted widespread famine.

Asian farmers began to plant semi dwarf varieties in late 1966 when a variety called IR- 8[36] was selected from IRRI's eight hybridization, which was made in 1962. Farmers adopted IR- 8 so rapidly that the press dubbed it the "Miracle Rice". The new HYV of rice recorded faster diffusion than any agricultural innovation across the globe. By the late 1960s, approximately 25% of the third world's rice was planted with IR-8 or similar semi dwarf varieties and by 1986, approximately 55 %(CGIAR).

IR-8 was not the first semi dwarf rice variety in tropical Asia. Taichung Native 1 (TN1) had been released in 1956 from DGWG/Tsai-Yuan-Chon, a 1949 hybridization made in Taiwan[37].Diffusion of both the variety shown the example of free exchange of movement of crop genetic resources without any payment and legal procedure. In the decade of 1970- 80, hundreds of semi –dwarf varieties were released in Asian countries notably in India namely jyothi, TKM-9, Pusa-44, and Sabri. IR-20 released in 1969, replaced IR-8 due to its genetic resistance to tungro virus, bacterial leaf blight, stem

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[34] Bala Ravi, S.; Trends in rice Trade and New Opportunities with Traditional Speciality Rice; Rice India.pp85-90

[35] Paddock., and P.Paddock(1967)Famine-1975

[36]IR -8=Peta cross Dee-Geo-Woo-Gen.
IR-8's female parent was Peta, a tall but vigorous Indonesian variety. Peta had been derived from a 1934 cross, in which sina was bread –as the female parent-to latisail (Van Der Mullen, 1941). IR 8 male parents was Dee- Geo- Woo -Gen stiff –straw Chinese rice whose genes have semi dwarf stature not only to IR 8 but also to almost all subsequent varieties in tropical Asia.

[37] In 1960, 1 kg of TN-1 seed was introduced into India through a university of MISSOURI co-operative project, and in 1966 IRRI sent one ton of TN -1 to India.

borers, and green leaf hoppers.[38]On subsequent years various strains of IR were released for Asian subcontinent notably IR-26 and IR-36 .Most of the modern varieties are derivatives of existing varieties.

3.5. History of Rice Improvement in India

Rice had been recognized a vital crop for food security in India hence its improvement process began nearly a century back, but positive efforts were taken after freedom. Rice (*oryza sativa*) research in India started its glorious chapter as early as 1911 with major emphasis on collection and purification of locally grown land races.[39] Aiming rice improvement and breeding programme in view the first research centre was started in 1946 central rice research institute Cuttock Orrisa followed by all Indian coordinated rice improvement project (AICRIP) at Rajendranagar ,Hyderabad in 1965.[40] Several other bold steps were taken like setting up of Regional Rice Research station and state agricultural university. It gain momentum after establishment of International rice commission by FAO in 1947 and international rice research institute (IRRI) Philippines in 1960 for wide range testing of genotypes and better research coordination through state agricultural university.

3.6. Justification of Demand of Emerging Technology

The tools of science and technology changes from time to time, because invention is the continuous process and it is driven by demand. The technology of green revolution had fulfilled the requirement in the decades of 1970-90 but it is now not capable to fulfill the demand. This fact may be cleared from flowing table.

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[38] Pathak, M .D. H. M .Beachell, and F.Andress (1973) IR-20 a pest and diseases resistant high yielding rice varieties.int.rice.comm.news.22:1-8.

[39]Krishnaiha. K(1998) Rice (oryza sativa) Research In India, Indian Journal of Agricultural Sciences 68(8,special issues);385-95,august 1998 p

[40] Singh, S.S (1998) Crop Management Under Irrigated and Rainfed Condition, Rice, Kalyani Publishers. pp 58-93

Table 3.7. Trends in Rice Yield and Production in the Last Two Decades Compared to the First Two Decades of the Green Revolution in India

Growth rate in production(% year)		Growth in yield (% year)	
1970-1990	1990-2000	1970-90	1990-2000
2.93	1.51	2.36	1.30

Source:-FAOSTAT, 2003 pp. ?

The analysis of the above table clearly indicates that in the decades of 1970-90, a increasing trend in growth rate is recorded both in production and yield in comparison to period of 1990-2000 in which both the parameters shown decreasing trend. So, it may provide an evidence for adoption of new technology in field of rice crops to harness more amounts of production and productivity for the overgrowing population.

The impact of the breeding activities may be analyzed on the basis of variety released an indicator of the impact of breeding activities in different ecosystem and regions: another indicator is the increase in production and productivity over a period of time. This fact is supported by following table:

Table 3.8. Area and Productivity of Rice Crops in Different Ecosystem

Total area under Rice	**Irrigated**		**Rain fed/Upland**		**Flood Prone**		**Upland**	
	Area (%)	**Productivity (T/Ha)**	**Area (%)**	**Productivity (T/Ha)**	**Area (%)**	**Productivity (T/Ha)**	**Area (%)**	**Productivity (T/Ha)**
42.64 M.Ha	43.8	3.6	30.1	2.4	11.41	1.5	14.6	0.8

Source-FAO document repository assessed on 13/5/2006

On the basis of above table, it is evidenced that India having maximum area under irrigation in context to rice crops, it may be expanding to dry land, flood prone and upland. The yield gap is also wide between different ecologies so adoption of new technology may provide a bridge between these divides.

There is also yield gap in rice in comparison to developed countries so a holistic approach is needed to make this gap narrow between developed and developing world. The yield gap among different countries is presented in following table:-

Table 3.9. International Comparison of Yield Selected Commodity (Rice-2002) Rice/Paddy

Sl No	Country	Yield(kg/ha)
1	Bangladesh	3448
2	India	2915
3	Japan	6582
4	Myanmar	3532
5	Pakistan	2882
6	Thailand	2597
7	USA	7372
8	Egypt	9135
9	World	3916

Source: Ministry of Agriculture & Co-operation page 156, Economic Survey, Government of India

India is far behind USA and Japan in yield so bridging this gap is a daunting task in front of agronomist, plant breeders and policy makers. That is why most of the

scientist and policymakers continuously argued in favour of adoption of new emerging technologies in rice improvement and breeding programme.

There is an emerging challenge in front of scientific community to how to help maintain a continuous increase in food demands despite limited natural resources and declining cultivable land due to demographic change, urbanization and industrialization and water scarcity, in a justified manner that conserves soil, water and biotic resources from which all food come. That is why scientific community argued in favour of genomics technology with the integrated approach of maintaining public good by means of effective use of different components of science and technology.

3.7. Emerging Technologies in Rice

Previous technology was successful in fulfilling the contemporary demand and needs of the people. But, in the present era a stagnant trend is recorded in major cereal crops including rice which is unable to match with projected demand so adoption of new technologies seems to be justifiable. The high input responsive technology had immediate impact on production but after some time problems like land degradation, insect –pest resistance emerged. Resistant biotypes of many pests developed as indiscriminate use of pesticides causing ecological imbalance. Similar case is recorded with weeds. Use of nitrogenous fertilizer caused problem like 'methanoglobenomia' in children of Punjab. Environmental problem also became an issue.

The integrated approach was introduced in the 1980s in the formulation of technological recommendation for rice crop improvement programme and management, with the development of integrated pest management (IPM), integrated weed management (IWM) and integrated nutrient management (INM) Programmes.[41]

The new technology like hybrid rice[42] technology is adopted in some of the Asian country including china, where it is got immense success. India also adopted this. This

[41] Shastry,et.al(1994)

[42]China developed hybrid rice technology in decade of 1970s. Research on hybrid rice in India is initiated in year 1989.in 1989 ICAR APPROVED the technology which was latter supported by UNDP and within short span of time it proved its surprising results.

technology aims to increase the yield potential of rice beyond the level of inbred high-yielding varieties by exploiting the phenomenon of heterosis or hybrid vigour. Since most of the tropical rice growing countries in Asia have a high population rate and limited land for rice cultivation, there must be an increase in production per unit area per unit time in order to maintain food security. Hybrid rice seems to be a suitable option to meet this demand. Hybrid rice showed its more productivity over inbred HYV of green revolution. Study on comparison of yield of hybrid rice with inbred varieties also provided positive result. This fact is analyzed in following table.

Table 3.10. Yield Gains for Hybrid released for Cultivation in India

Sl. .No.	Hybrid (Tones/Ha)	Inbred(Tones/Ha)	Yield gain(Tones/Ha)	Yield gain (%)
1.	6.33	5.22	1.11.	21.3

Source: Directorate of Rice Research, India 2000

Note: hybrid 'Shayadri' over best inbred check 'Sasyasree' across 15 locations, multilocation trails, 1999/2000 Rabi

On the basis of above table one may argue in favour of hybrid rice due to more yield and economic advantages. This fact is also supported by K .Krishnaiha(1997), who argued that "these hybrids yielded about 15 % grain yield higher than the prevailing popular varieties".[43] The list of hybrid rice varieties released for cultivation in India is presented in following table:

[43] Krishnaiha, K.(1997)

Table 3.11. List of Hybrid Rice Varieties Released in India

Sl. .No.	Hybrid	Parentage	Year released	Origin
1.	CORH-1	IR58025/C2OR	1998	TAMILNADU
2.	ADTRH-1	IR58025A/IR66	1998	TAMILNADU
3.	SAHYADRI	IR58025A/BR287-35	1998	MAHARSTRA,INDIA/IARI
4.	NARENDRA SHANKRA DHAN	IR58025A/NDER3026	1998	UTTAR PARDES
5.	PA 6201	UNKNOWN	2000	BY HRI LTD.
6.	PUSA RH -10	UNKNOWN	2001	NEW DELHI
7.	RH-204	UNKNOWN	2001	BY MONSANO
8.	HR-120	UNKNOWN	2001	BY HRI LIMITED
9.	27P-O2	UNKNOWN	2001	BY PIONEER LIMITED

Source:-FAO document repository assessed on 13/5/2006

There is also a demand of use of most recent technology in crop improvement like biotechnology from several sectors, supported by increasing demand of food grains and yield gap. Biotechnology is most recent innovation in agricultural sector and it might have several positive and negative implications on rice cultivation. But, rice in many parts of the world, especially Africa and Latin America has benefited from some intervention of biotechnology such as embryo rescue and anther culture achieving high yields and quality improvements.[44] Genetic engineering supported by gene mapping, gene tagging and gene transfer techniques is emerging as a potential tool to combat the problems of malnutrition and hunger in third world countries.

This technology initiated debate in India, issues like the rate of adoption and success rate of technology, socio-economic impacts of GM rice ,environmental concern, divide between farming society are often debated –some facts and figures and some with assumption. There are two schools of thought one is in favour of its adoption but other is

[44] UNDP, 2001, Human Development Report .Oxford University Press. USA.

totally opposition of it. Year 2004 is celebrated as year of rice. The interest of multinational companies like syngenta in rice genome project created a discourse for NGO activist; they strongly argued that the application of new technology may provide a way for converting public good into private due to monopoly element of intellectual property rights.

But, it is also argued that there is some positive impact of rice genome project may not be ignored for future breeding programme. Because due to its small genome size about 430 MB, availability of the whole genome sequence, perhaps the first food crop which such information is available[45] may likely to create new vistas of crop science research. Because of the conservation of gene sequences of plants, complete sequencing of rice has broad practical implication for many other economically important crops.[46]

There is a large gap between potential and actual yield of rice crop in India. In this condition, most of the scientists are in favour of adoption of this technology for bridging the gap between actual and potential yield. Among the various techniques used in tissue and cell culture, induction and selection of useful mutants at the cellular level is probably the most promising approach to rice improvement.[47] The tissue culture technique may provide way to increase lysine content of rice.[48] The use of tools of biotechnological application in rice improvement is presented below in the table:

[45] Goff S.A. et al.2002 A Draft Sequence of The Rice Genome
[46] Sommerville, C.and S .Somerville ,Science 285,380(1999); K.M.Devos and M.D. Gale, Plant Cell 12,637(2000)
[47] Swaminathan. M .S. Biotechnology Research and Third World Agriculture Science vol.218. 3 December 1982
[48] Schiffer G .W .and F .T Sharpe,JR..In Vitro 17.345 (1981)

Table 3.12. Possible Application of Biotechnology Research to Rice Improvement

Sl. No.	Research technique	End results
1.	Tissue and cell culture Induction and selection of useful mutants at the cellular level	Salt tolerance Aluminum toxicity tolerance High lysine and high protein Low photorespiration Disease resistant Low oxygen tolerance
2.	Embryo culture	Intra and inter specific hybridization
3.	Anther and pollen culture	Reducing breeding time
4.	Protoplast fusion	Interspecific and intergeneric hybridization Hybrid rice improvement Azolla improvement
5.	Genetic engineering	Incorporation of nitrogen fixing genes

Source:-Page No.969, Biotechnology Research and Third World Agriculture M .S. Swaminathan, Science Vol.218. 3 December 1982

The biotechnological innovation is structured in India during 1990s on deployment of cellular and molecular techniques in two important areas namely gene transformation and gene characterization (DNA marker technologies), wide hybridization, tissue and anther culture also being persuaded with specific objective.[49]Most of the BT research in India is concentrate on quality improvement and resistant varieties. However, till this dates no BT varieties of rice is recommended for

[49] Krisnaiha, k(1998)

cultivation in India but several projects is ongoing by both public and private sector in rice improvement and breeding.

3.8. Emerging Issues and Challenges Associated with Emerging Technology

With the advent of the new technology, several issues were also generated due to existence of various types of divides in research and development structure of developing world countries. Every technology has several types of positive and negative impact on society; previous experience also provided such example. There is a wide gap between technology generator countries and technology consumer countries in different aspects like transfer, diffusion, dissemination and distribution of modern technology. The acceptance of new innovation depends upon several factors like technological capability of the particular country. Country having nascent or less developed infrastructure and R & D organization is unable to cope with the new situation. The impact of new technology may be analysed at several aspects like social, economic as well as environmental. India is the country, where most of the farmers belong to small and marginal section, so there may be a question of failure in comparison to rich farmer .The ability to bear the cost of new technology also creates several implications within the farming community. Some argued that the new technology will create a wide divide between resources rich rice farmers and resources poor rice farmers with the argument that technologies are rich biased. Biotechnological revolution in agriculture may hamper the economics of the traditional rice growers due to lack of competence to adopt new technology.

There is also a chance to monopolization of third world crop genetic resources due to patent and plant breeders' right .There is a probability of usurpation of seed market of third world by means of GURT technology by Transnational corporate. Several concerns are expressed about bio-piracy of resources. The traditional varieties contain several qualitative genes, which may be polluted by monoculture of specific varieties of crops in new scenario. Concerns are also expressed about emergence of genetic erosion due to monoculture of specific variety as well as genetic pollution. Varietal diversification of several crops like rice may be affected by new scenario. It is estimated

that one-third of India's, rice area was occupied by seven popular varieties. 15 % of this area was planted with varieties released before 1980 while farmers continued to plant traditional varieties on 19 % of the area.[50]In the previous situation, most of the varieties are developed by chance selection of genetic resources but in new situation due to insertion of genes several genetic consequences may arise.

There is a proverb that says –"chance favours prepared mind", in the new scenario whose chance will favour, is it multinational corporate or traditional farmers still to be assessed. Science and technology also shapes the direction of research in agriculture, in new dimension, there may be chance of more thrust on cash or commercial crops in comparison to food crops. It is also argued that Impact may also likely vary from crop to crop, between commercial and food crops and amongst different section of farming communities.

Fears have been expressed that genetic resources originating in developing countries will be used for the development of new agri-BT based techniques and products by the industrialized countries, and to which biotechniques and byproducts access would subsequently be restricted by IPRs. Also, it is argued that strengthened IPRs would increase the flow of technologies and products from developed to developing countries, and would provide new incentive for local research and innovation.

The challenge is to develop a shared vision for rice research that will provide the public sector access and freedom to use modern tools and sufficient incentives for the private sector to innovate, develop and deliver new rice technologies for the betterment of the commons.

There is also emerging concern to identification of genetic diversity and characterization of such diversity is the backbone for any future improvement in rice-both by traditional and biotechnological means-the ability of countries to use the diversity for increasing local production is critical challenge.

[50] Janaih and Hossain (2002)

3.9. Research Priorities

Maintaining food and nutritional security is the major concern of developing world countries without hampering their genetic resources and environment is the agenda on which research priorities should be based in new trade regime. It is argued that research priorities must be based on the demand of larger section of the society. There is a challenge in front of scientist and policymakers to feed the overgrowing population, so rice research must be shaped in that direction which may give more production and yield without eroding the environment and genetic base of the crop. If biotechnology is to have an impact on the lives of the poor, it must focus on the problems of too much and too little water, soil toxicity, and low soil fertility, as well as on inadequate grain quality and nutrition.[51]The research is also based on giving equal importance to traditional varieties as well as new varieties. Golden –A rice and iron rich rice are some noteworthy example. Enhancing the nutritional status of the grain may be a major concern for further research. Some of the traditional varieties grown in tribal areas may provide genetic stock for nutritional trait for insertion in new varieties.

The two –third of the arable land of India comes under dry land, so new plant types must be innovated suited for that particular locality having water stress is common phenomenon. The revolution in the science of molecular biology has increased the possibility of research success in developing appropriate technologies for rainfed environments.[52]Therefore, need is to develop rice varieties for different agro climatic condition of India is major concern for further research.

3.10. Issues of Intellectual Property Management in Rice

After enactment of TRIPS ART 27.3 (b) and patent amendment act 2005, several debatable issues emerged in front of scientific community as well as policymakers. From basmati patent issue, India should take lesson for IPR management in crop genetic resources. There is lack of awareness within traditional keeper of genetic resources so

[51] Casman, K. .proc.natl. acd .sci.USA 96.5952(1999)
[52] Hossain et al 2000

government should come forward to make them aware about their resources. The IPR institution is also at nascent stage so they may be further strengthened for facing the challenges in new liberalized regime. Plant patent first time came within preview of patent act in India. There is need to initiation of documentation of all crops in India so no one may get patent on our own resources. There is also case of geographical appellation in case of basmati rice and other traditional varieties. The name basmati is derived from the name of a place in Dehradun situated in Utrakhand .So, this name has geographical significance.

Whether or not biotechnology research will ultimately contribute to attaining and sustaining food and nutrition security, depends on multiple factors like the investment in biotechnological research in public sector institutions: how national governments and the international rice research community addresses the issues of patenting and IPRs: and the promotion of a socio-political environment for impartial assessment of the benefits and risks of biotechnology.[53]

[53] Hossain , M. and Josephine .H. Narciso :New Rice Technologies and Challenges for Food Security in Asia and Pacific, Head and Database Administrator, social sciences division, IRRI ,Manila, Philippines

Chapter –IV

TRIPS Article 27.3 (B), IPR and Indian Agriculture

4.1. The origin of the TRIPS

Uruguay round of GATT negotiation may be considered as the point of origin of TRIPS. The Uruguay round was started in September 1986 had extended over seven years. With the successful conclusion of that round and multilateral trade negotiation on April 15, 1994, GATT was succeeded by an intergovernmental organization namely the WTO. The concerns for inclusion of intellectual property rights for the first time in global trade negotiation was raised at very outset of the Uruguay round in 1986, despite objections from some major developing countries. Until then, IPRs had not descended in varieties of trade-related or non trade related. In December 1991, Arthur Dunkel, than Director –General of GATT, proposed a complete draft accord to help negotiators to concentrate on draft final text .After a number of debates between developing world and developed world the Dunkel text went into the draft final act of Uruguay round. During the whole period of negotiation between 1986 and 1993, the strategy of some of the developing countries was concentrated on containing the expansion of TRIPS agenda. When the agreement was finally signed, they had obtained through the negotiations a number of improvements and flexibilities in the text, which seemed a good starting point.[1]

4.2. Article 27.3(B)

The earth summit on the convention of biological diversity (CBD) accorded in year 1992, sovereign rights to a state of its biological resources, which hitherto were regarded as heritage of humankind. The Uruguay round multilateral trade negotiation also

[1]Ali Khan and Mashelkar (2002)

emphasized on the inclusion of living entities under a global regulatory framework, which led chaos among developing and developed world. During the course of debate, discussion and discourse of the agreements three main types of proposals were put forwarded,

1. An exclusion of plant varieties and essentially biological processes, other than microbiological processes or the products there of.

2. Plant varieties should be protected either by patent or by an effective *sui generis* system[2].

3. Member countries would be free to exclude from patentability, if they so wished, or plant or animal invention, biological processes and biotechnology.

The outcome of negotiations was a compromise of last two proposals and this constituted the article 27.3(B).Intellectual property protection became a central concern of agricultural policy in the context of TRIPS commitments under WTO obligation. TRIPS agreement is a broad ranging treaty, which had impact at various levels. The most debatable article 27.3(b) states that-

"plants and animal other than micro-organism, and essentially biological processes for the production of plants and animals other than non biological and microbiological processes .However, member shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this subparagraph shall be reviewed four years after the date of entry into force of the WTO agreement".[3]

4.3. Meaning of the certain term of Article 27.3 (B)

The central issue is that -what are the actual meaning of the words "effective" and '*sui generis*" in context to this article? The interpretation of the word is too difficult, because its meaning depends upon the condition and position of the country. Both the

[2] sui generis system-a unique system (of IPR) designed to meet certain criteria
[3] http://www.cptech.org/ip/health?cl_cl_clart27.html

developing and developed world has different system of effective enforcement so far the plant protection is concerned in new regime. The TRIPS agreement provides an indication of possible meaning of the term effective, this article employs the term effective in particular in the context of the national enforcement of rights and procedure for the multilateral prevention and settlement of disputes, in which the rights to be conferred by an IPR are either defined in detail or as "equitable remuneration".[4] This formulation argues that a sui generis system needs to allow effective action against any act of infringements, as required by the relevant article of the TRIPS agreement. The major limitation of this approach is that the effectiveness of a sui generis system thus assessed does not depend on the requirements for, or on the level of protection.[5]

This article does not defined microbiological process and kind of living entities which may be protected under new IPRs regime.[6]This is the strong point at which one may strongly demand the review of TRIPS, otherwise confusion will not be eradicated within scientific community as well as in policy makers.

TRIPS article 27.3(b) made provisions for the first time ever, IPR such as patents or a sui generis system, on plant varieties, provided the varieties are new involve an inventive step and are capable of industrial application. The member state of WTO has given some flexibility to exclude patents, but would have to adopt "effective sui generis system" instead. developing countries were given, through provisions of TRIPS article 65 and 66,four years transition period and least developed countries 10 years to implement the TRIPS agreement .The deadline for developing countries expired on January 2000.For the least developed countries (LDCs),time was given until 2006,which later at the fourth session of the WTO ministerial conference held in Doha(Qatar) 2001 ,was further extended with respect to their obligation concerning patent protection for pharmaceutical products, until January 2016.

Several times, it is argued that developing countries have been forces to agree to TRIPS. The term developing country is not clearly described by the WTO. Member

[4] Dhar, Biswajit (2002)
[5]Dhar, Biswajit(2002)
[6] Desai,P.N(2003)

states, themselves declared their status as developing country. Many developing countries had changed their IPRs regulation under obligation of TRIPS. Both sides of counterparts have their own concept about new trade regime. The proponents of TRIPS argues that the negative short to medium term effects, may occur like increased cost of products and more difficult access to technology due to several legal procedure but it may create long term benefits like the protection of domestic invention and development of innovative sprit. The developing world argued at several meetings of WTO about biopiracy and non-competitiveness of their economy in context to new regime but counter argument is also done by developed world, they argued that new IPR protection might have positive impact on transfer, dissemination and diffusion of technology and investment flow.

In the new scenario, the governments of developing world have had and have to find a balance between the need to protect intellectual property and to requirement to diffuse certain technology in order to increase public welfare. The confrontation between developing world and developed world is continuous until this date about new TRIPS Regime. Developing world demanded review of the TRIPS but developed world want to accept the regime *in toto,* because it fits good in their already existing pattern of IPR protection.

Most of the developing world countries have ill-developed pattern of science and technology in context to developed nation they have well developed and advanced status of S & T organization and institution. Therefore, there may chance for arising a situation of struggle between unequal both in resources and level of competence. In opposition to it, this is argued that developing nation have immense source of work force and bio-wealth; if they should be utilized in efficient manner, they became gainer in new trade regime. It seems that the question of competitiveness may have wide implication between both the poles of the world.

Md. Izhar Ahmad (2005) argued in opposition of TRIPS that the agreements prime objective was not the battle against counterfeiting and piracy but "technological protectionism". Developed countries are regarded as innovators and suppliers of product

but developed world serve as market.[7] Correa also said that TRIPS is tailor made for developed countries but disregards essential difference between capabilities of countries between north and south.[8] In the context of new regime, one argued that there may be favourable chance of commercialization of life industry and biotechnology. One group asserts that new regulation of IPR is vital for widening the technological territory but other group confronted it due to threat of non-competitiveness of their technology. It has been argued by developing countries that time is needed to acquire experience on the level of protection necessary and desirable, and the exception and balance necessary for ethical, social and economics needs of people.[9]

4.4. TRIPS and Agriculture

After various studies, two main aspects may be highlighted in context of agriculture. First major debatable aspect is that this agreement provides for the introduction of life patenting, such as patents on micro-organisms, in all the member states of WTO. The second aspect is this article mandates the introduction of a form of intellectual property protection for plant varieties. This has made intellectual property protection a central theme of agricultural policy in the context of the implementation of the TRIPS commitment.

4.5. Before and after Doha

During the 11 years of TRIPS agreement, developing countries have been disappointed to discover several asymmetries and inequalities inherent in the agreements, which were not fit to their trade interests due to technological, institutional and infrastructural divide. These concerns were raised at several meets and WTO was urged repeatedly to first attend to these implementation issues before widening the coverage of the WTO in the fourth ministerial conference in this in the Doha deliberation with

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[7] Ahmad, Md. Izhar (2005)
[8] Correa Carlos(2000)
[9] Thamarajkashi, R (2002) Doha Declaration and Agriculture in Developing Countries, Economic and Political Weekly ,January 5,2002 p23-27.

reference to agriculture in developing countries in the light of the implementation concerns raised by them.

Developing countries continuously argued in TRIPS council about- how to apply the exiting TRIPS provision on whether or not to patent plants and animals, and whether they need to be modified. Developing countries also asked about the actual meaning of effective enforcement. Developing countries actually wanted to accept sui generis system instead of life patenting. They have also raised serious concern about handling moral and ethical issues about life patenting. They have also raised serious concerns about their traditional knowledge and genetic materials. Developing countries also wanted to know from TRIPS council –how to ensure that the TRIPS agreement and the UN convention on biological diversity support each other. However, in year 2001 Doha declaration tried to clear that the WTO is also seriously concerned with these issues and want to establish a relationship between the TRIPS Agreement and CBD; the protection of TK and biodiversity and other relevant new developments that member governments raise in the review of TRIPS article.

Developing countries and India has had a still option of forcing the developed world to rethink the concept of life patenting because it create certain confusion between CBD and TRIPS agreement. The CBD expects its signatories to respect the sovereignty of nations over their bio-diversity. In the agreement of TRIPS there exist today no clauses, using which the countries can get today the IPR holders to produce legally binding agreement for material and information transfer with the owners of original biological resources. African group seeks a review of the TRIPS agreement on both the issue of what is sui generis and the issues of exclusion of plants, animals and micro-organisms from the scope of patentability.[10]

4.6. Intellectual Property Rights

Intellectual Property Rights may be defined as statutory rights which allow the creator or owner of the innovation to prevent others for exploiting the same commercial

[10] Abrol Dinesh

product for a certain period of time. Jayashree Watal (1988) defined IPR as legal rights over, creative or inventive ideas. Such legal rights generally allow rights holders to exclude the unauthorized commercial use of their creation or invention by third persons. The rationale for the establishment of a legal framework on IPRs is that it is a signal to society that creative and inventive ideas will be awarded.[11]

IPRs confer on the owner a monopoly of production and distribution of products in a specified territory for given period of time along with social obligation of disclosing information.[12] Intellectual property rights can provide us one of many incentives for recognizing, respecting and rewarding innovators as well as traditional knowledge holders in the field of agriculture and other wild bio-diversity.[13]IPR can be defined as a set of laws devised for the purpose of protecting or rewarding inventors or creators of new knowledge.[14]

Intellectual Property is defined in an all pervasive sense in article 2 (viii) of the convention establishing the world intellectual property organization(WIPO) signed at Stockholm on July 14,1967, to include the rights relating to literary, artistic and scientific works: performance of performing artists ,phonograms and broadcasts ;invention in all fields of human endeavour; scientific discoveries; industrial designs; trademarks, service marks and commercial name and designations; protection against unfair competition; and importantly ,specifies "and all other rights resulting from intellectual activity in the industrial ,scientific, literacy or artistic fields".[15]

Intellectual Property system includes laws, mechanism, instruments, organization for protection, administration and enforcement and judicious use of intellectual assets for development of society and mankind.

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[11] Watal, Jayashree(July 1988)
[12] Desai , Pranav N(2003)
[13] Gupta, Anil K
[14] Malik and Jafar (2005)
[15] Ali khan and Mashelkar(2004)

4.7. History of IPRs

Intellectual property right is not a modern concept, its root can be traced back in the history of 15th century when invention of the printing press enabled coping of literacy works. This illegitimate copying led to the emergence of certain statutes to protect individual creation and invention. That was the beginning of the journey of IPRS which has now taken a global shape in the form of WIPO and TRIPS.[16]

Dr .Desai (2003) analysed and studied history of the intellectual property rights and stated that Origins of Intellectual Property Protection (IPP) lie perhaps in the secrecy or reluctance on the part of inventor to disclose the information out of fear that the creative ideas would be stolen and commercialized by others. Though, some of the early system of granting exclusive privileges on inventors can be traced back to even 500 B.C. in Italy or later in 15th and 16th century in England, the modern patent legislation has evolved during 18th and 19th century in Europe and the USA. This system evolved during the period of rapid industrialization and the nature, scope and strength of IPP evolved according to the level of economic and technological development of each country. Certain level of flexibility was also provided in the international IPR system that evolved in the late 19th and early 20th century up to the present level.[17]

4.8. Forms of IPRs

Historically, there are two broad categories of IPRs: first is an industrial property right which includes patents, trademarks, geographical indications and industrial designs; second is copyright and related rights including artistic and literary works, performances, broadcasts and likes. With the modernization of science and technology several new avenues and dimension appeared in world arena of science and to include them within preview of IPR mechanism a new concept of 'sui generis ',meaning one –of-its kind is emerged .such sui generis right covers lay-out designs of semi-conductor chips and plant breeder rights. It seems that the sui generis system is very relevant to IT revolution and

[16] Naquvi Hena (2006)
[17] Desai .P.N.(2003)

BT revolution. These tools of IPRs are very important for the protection of originality and creativity of human mind .according to TRIPS agreement, intellectual property rights can be divided into seven areas:-

1. Copyright and related rights
2. Trade marks
3. Industrial design
4. Layout Design (topographies) of integrated circuit
5. Patent
6. Geographical Indication
7. Protection of Plant Varieties and Plant Breeders Rights

Among them different forms of IPRs which is used in agriculture are patents, geographical indications, plant variety protections, designs, trademarks and trade secrets. All of these have a part to play in the development and commercialization of plant products but none of these create as much as attention as patents, plant variety protection and geographical indication.

4.8.1. Copyright and Related Rights

Copyright and related rights may be defined as a tool of intellectual property protection for the original literary works .i.e. books, novels. Lyrics, songs, computer programmes etc. The concept of copy rights and related rights originated from Berne convention .India is also one of the signatory of Berne convention. A copyright covers every original work of authorship; irrespective of its literary or artistic value or merit. It is design to promote creativity of authors and creators of literary and artistic work. This right prevents owner of creativity from copying, duplicating and reproducing of same work by others.

The role of copyright in development at the national level, is to encourage creativeness; promote tertiary industry (books, entertainment, records, films, etc);

promote the activities of the media (radio, television, cinema, press); while at the international level, it is to facilitates cultural exchanges; achieve integration in international relations (membership of multilateral treaties); and increase the role of countries within the international community.[18]

4.8.2. Trade Mark

A trade mark can be a logo, a symbol, word, phrase, jingle, picture, sound or even smell or a combination of all these which is used to distinguish one work/services from another. It provides a distinct identity to a particular good, services or commodity and protects it from usurpation.

The modern concept of trademark developed in parallel with industrial mass production ,dates back to about two centuries; the enhanced circulation of good and services has now made it increasingly necessary to use a distinctive mark or name to identify a product, services or enterprise. Trademark is also significant because it also ensures the grantee of quality.

Trademarks are distinctive signs capable of distinguishing and identifying goods or services produced or provided by one enterprise from those of others producing similar goods or services.

4.8.3. Industrial Design

A design is the presentation of the whole or a part of product resulting from the features, of colour, size, shape, texture or materials of a product or its packaging.

This is applicable to the industrial product and handicrafts. Industrial design protection relates to features of shape, configuration, pattern or ornamentation of any article made by industrial process or handicrafts. it is required that an industrial design must be registered in order to be protected under the industrial design law of a country

[18] Ali Khan and Mashelkar (2004)

.Both two and three dimensional design can be registered to the concerned patent office ,or to its design registry, where such a branch exist.

4.8.4. Layout Design (Topographies) of Integrated Circuits

With the advancement of the semiconductor technology, a new type of protection mechanism is felt and WIPO adopted a new type of protection measures known as layout design of integrated circuit. Ten year protection term is given to the owner of a particular creation. It is felt that among world community creation of a new layout design of an integrated circuit may involve huge investment and mental labour but its copying may cost very little as compared to cost in creation.

4.8.5. Patent

The term "patent'' originates from the Latin word "patere" which means "to lay open" (i.e. make available for public inspection) and the term patent, which originally denoted royal decrees granting exclusive rights to certain individual or businesses

A patent is defined as exclusive rights for a limited period of time (term of patent) granted by the government to the patentee, in lieu of full disclosure (complete specification) of the invention for sake of information as well fulfill the scientific ethos of public welfare.

It is also defined As a set of exclusive rights granted by state for a fixed period of time in exchange for a regulated ,public disclosure of certain details of a device ,method, processes or composition of matter (substance) (known as invention), which is new, inventive, and useful or industrially applicable.

DR .R. A. Mashelkar and Shaid Alikhan(2004) defined patent as an exclusive right granted by the government patent or intellectual property office to an inventors to

prevent others from making, using, selling, distributing, and importing his new product or processes. This right is granted for a limited period of time.[19]

Article 27 of TRIPS agreement provides that the WTO member state shall provide patents for any invention either a product or process provided that they are new involve a inventive steps and capable of industrial relations Thus, before a patent can be granted it should be shown that the invention is novel and useful; and not so obvious to anyone interested in the subject. It should also be capable of practical application.

The public policy behind the patent system is to encourage patentee to share their discoveries with the commons and thereby advance the general status of technology. This is also argued that by the patent the knowledge of innovator is preserved for the benefit of society. The main aim of patent is to provide information for the public .This information is also considered Useful in many ways in the advancement of S &T. For purpose of definition, WIPO describes a patent as a document issued by a government office, which describes the invention and creates a legal situation in which the patented invention can normally only be exploited (made, used, sold, imported) with the authorization of the patentee. The protection of the innovation is limited in time (generally, 15 to 20 years).[20]

There is a number of arguments in favour and opposition of this form of rights. One group supports patent with the argument that this monopoly right on invention will promote innovators to do better invention for the society so he can make more profit and get more status. This will enhance capability of innovators and also status of science and technology. But, counter lobby of thinkers argues that it will hamper free flow of movement of scientific thought, ideas and invention for general mass.

This is argued that the system of monopoly patent claimed to have been developed not only to induce inventive activity but also to increase S & T knowledge base in the society by encouraging the inventor to disclose his secret. "the critics of the patent system argues that the system actually block the industrial development in least developed countries because it does not serve the two claimed functions, namely (i)

[19] Ali khan and Mashelkar(2004)
[20] Ibid

inducing the transfer of technology and (ii)promoting R&D and technological innovation.[21]

4.8.5.1. History of Patents

The word patent had been coined from the word "letters patent" issued by the British crown. The history of the patent mainly is traced in Europe. Its global history is 1000 years back. In year 1200 A.D., a 10 year monopoly granted in Venice Italy to inventors to silk device. From the historical literature, first recorded patent granted in England for a glass making process and up to 1880-1882 most of the European countries instituted the patent statutes.[22]

Patent policy has a long history in India, dating back to 1856[23], but the actual attention of policymakers towards patent began right after independence. The two patent inquiry committee was constituted by the government of India respectively, the patent enquiry committee (1948-50) headed by Bakshi Tek Chand and The Ayyangar committee (1957-59). The Indian patent act of 1970 was based on the recommendation of these two committees and made for the self reliance and self compatibility on development of Indian science and technology as well as industry. The major cause behind setting up of these committees was to make a patent policy free from colonial element of previous policy, which was more suitable for trans-national corporate. there was a lot of opposition raised by a powerful lobby of TNCs in India and abroad and the introduction of India's first patent act was delayed for more than ten years and such a bill was allowed to lapse in Indian lower house more than once.[24]The modified Indian patent act of 1970 became operative from 1972 and was a landmark in the history of Indian technological development and sought to "make patent work for the nation", thus, reversing regressive

[21]Karim, A.S(1985)
[22] See Annexure
[23] See Annexure
[24] Mehrotra,N.N(1989)

aspects of colonial act. This act was made to establish a balance between the rights of patentee and welfare of Indian people[25].

This act was very relevant because it was based on product patent not both process and product patent. It also excluded elements of life patenting like a method for agriculture or horticulture and any process for the medicinal, surgical, curative, prophylactic or other treatments of human being or any processes for a similar treatment of animals or plants to render them free of diseases or to increase their economic value or that of their products.

The patent act of 1970 and regulations framed under don't make any mention of "biotechnology" or micro-organisms as the patentable subject matter. Accordingly, the life entities and materials like animals, plants, microbes, and viruses are not patentable under the patent act. However, inventions relating to the processes for the production of substances like enzymes, antibiotics, alcohol etc. bioconversions utilizing microbes or ferments are patentable.

After the acceptance of TRIPS under WTO obligation, there is need to reorient or redirect existing patent policy in India is also sought in various stakeholders. Rapid industrialization and growing competence in Indian science and technological organization accelerated the rate of demand of new patent framework under the guidelines of TRIPS .Indian governments amended its patent act of 1970.

The patent amendment act (1999) provides for filling application for product patenting for medicine or drugs or for grant of exclusive rights to sell or distribute the article or substances in India. government of India passed its third patent amendment in year 2005 incompliance to TRIPS ,which led the birth of new process –product regime as well as life patent. The comparison of the 1970 patent act and patent amendment under trips is presented in following table

[25] Ragnekar ,Dwijen(2005)

Table 4.1. Comparison of India's Patent Act (1970) and TRIPS

Sl. No.	IPA 1970	TRIPS
1	Only processes not product patents in food ,medicine and chemicals	Both processes as well as product patent in all fields of technology
2.	Terms of patents 14 years :5-7 years in chemical	It is increased to 20 years.
3.	Compulsory licensing and license of right	Limited compulsory licensing ,no license of right
4.	Several areas excluded like agriculture horticulture and any processes for medicinal, surgical or other treatments of human or similar treatment of animals and plant render them free of diseases or increase economic value of product	Almost all field of technology patentable. Plant varieties excluded from patent protection, but confusion exists on protection in some areas of agriculture and biotechnology.
5.	Government allowed to use patented invention to prevent scarcity	Very limited scope for government to use patented invention

Source: Adapted from Patent Office Technical Society, Indian Patent Act, 1970 and Rules 1991 and MVIRDC, GATT Agreements; Results of the Uruguay Round, World Trade Centre, January 1995.

4.8.5.2. Life Patent

TRIPS article 27. 3(b) and new patent amendment act has led to the birth of concept of life patent or bio-patent in India. In developed world this is not a new concept, but in India it is new innovation. The plant patent is started in USA in year 1930 and the issue of life patent first time emerged in year 1980 when an India born US scientist Anand Chakrobraty taken a patent of bacterium which was able to feed oils in sea .In the context of the developing world this new instrument of science may have several implication which may be observed on later dates. Some argue that the new life patent

regime may cause severe damage to natural resources of third world. Some see it as a cause of several social, economical as well ethical problems.

Some argue that patent laws are made before the biotechnological revolution so it may create new challenges for using crop germplasm which had been considered from time immemorial a common good. One argues that commercialization and commoditization of agricultural seed was a crucial event establishing the commercial precedent for life patents .Kloppenburg (1988) stated that with the development of superior seeds that were functionally sterile, seed saving, which had been an on-farm activity, was transformed into a commercial activity.

There may be chance of appropriationism of seed.[26] Life patents are seen by life industries as pivotal to profiting from agricultural biotechnology. Without the assurance of controlling commercial application, the life industries argue they could not justify the tremendous capital investment in biotechnology research to their stakeholders.

There are some deep ethical issues raised by the some religious leader about life patenting and patenting of genetically modified organisms. Some major concerns raised by several stakeholders involved in debate of life patenting are presented in following points:

1. There may be chances of damper on research in case of agricultural and medical biotechnology due to life patent in third world,

2. There may be chances of widening the gap between the industrialized north and genetic variability rich south because knowledge of agricultural biotechnology may be held in monopoly by the industrial north.

3. Investors in biotech firms may likely direct its application for profit, not for addressing critical societal goals like food and nutrition security

4. There may be chance of appropriatisation of indigenous knowledge and agro biodiversity

5. Small and marginal farmers become dependent upon seed companies.

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[26] Goodman (1991)

6. There may be chances of genetic erosion as well as genetic pollution.

Some asserted that the problem of monopoly is nothing new in agriculture, but unlike previous monopolies over land and transportation, they are now witnessing economic control over the reproduction of life itself. Bruce and Bruce (1998) stated that patenting of life forms constitute an unwarranted extension of private ownership because it furthers the process of commodification.[27]

4.8.6. Geographical Indication

Dr. Desai (2003) defined "A geographical indication is a sign used on goods that have a specific geographical origin and possess qualities or a reputation that are due to that place of origin. Most commonly, a geographical indication consists of the name of the place of origin of the goods".[28]

Dr .R.A Mashelkar and Shaid Ali khan (2004) stated that Geographical indications are defined as indications identifying goods as originating in the territory of a country, region or locality, with a quality, reputation or characteristics attributable to its geographical origin. It refers simultaneously both "indication of sources" and "appellation of origin".[29]

The protection based on GI is to be found in section 3 of TRIPS. Article 22 to 24 deals with the protection of goods that are geographically indicated. The concept of GI is addressed to some extant in the Paris convention (article 10), and is dealt with more specifically by the Lisbon agreement for the protection of appellation of origin and their international registration (1958, revised at Stockholm 1967, and amended in 1979; the latest regulation as in force on April 1, 2002).[30]

The GI is the origin of European mindset to preserve their resources in field of wines and spirit, but third world have more economically and socially vital public good which may need this type of protection .There is wide divide between both the

[27] Bruce and Bruce (1998)
[28] Desai, P.N.(2003)
[29] Alikhan and Mashelkar (2004)
[30] Ali khan and Mashelkar(2004)

counterparts on the issues of GIs because developing world does not want to extend this norms to third world heritage. India demanded its extension to her resources and raised the important issue in various WTO summits and ministerial conferences. For country like India, natural resources are not only important for gaining certain protection but their economic importances too, just like witnessed in basmati issues.[31]

Dr. Suman Sahai critically analysed the economic importance of geographical appellation in context to rice and stated that the current export of basmati rice from India is to the tune of Rs.18000 Crores. Pakistan exports somewhat more than that .The revenue from all the basmati rice sold in the world market goes either to India or Pakistan[32] .That is the strong economic incentives to have a geographically protected name and not allow others to use it.

Dr. Desai (2003) linked the concept of GI with traditional knowledge and raised a serious question - To what extent GIs can protect TK and promote economic development for the developing countries might require a serious exercise.[33] India has a large number of resources which may be able to get this protection, which is tabulated below:

Table 4.2. Need for Extension of GI in Following Resources

Sl No.	Name
1.	Basmati Rice
2.	Darjeeling Tea
3.	Neem
4.	Jamun
5.	Sahi Litchi
6.	Alphonso Mango
7.	Ocimum Plant
8.	Nagpur Orange
9.	Kolhapuri Chappls
10.	Bikaneri Bhujia
11.	Agra Petha

Source: compiled from various articles of Desai, Watal, Sahai and Mashelkar

[31] Sahai ,Suman: WTO/TRIPS: Areas of concern for India
[32] ibid
[33] Desai,P.N.(2003)

4.8.7. Plant Breeders Right

This is the one of the most important tool of IPRs which has certain superiority over patents. The concept is originated from UPOV convention in 1961. The PVP or PBR allows for the protection of new plant varieties for a period of 20 years for crop and 25 years for trees. This is referred as a sui generis system; most of the developing world country adopted it.

4.9. Implications of IPRs in Indian agriculture

The impact of IPRs in context to Indian agriculture may be analysed at several factors like social, economical and institutional. There are several polarized thoughts about the implication of TRIPS article on Indian agriculture. Each and every stakeholder has their own suspicion and argument about new trade regime.

However, forms of IPRs are in nascent stage in India, it will take time to analyse real impact, but one may forecast and predict about the shaping and direction of Indian agriculture on the basis of past experience of transfer and diffusion of technology.

Some see that new regime will provide a better way for the transfer of technology and movement of plant genetic resources because due to plant breeder's right, no one can commercially exploit without prior informed consent. Other group argues that it will restrict the movement because it requires more legal and paper work.

Impact of IPRs in context to Indian agriculture is analysed at following subheads:-

4.9.1. IPRs and Variety Development

The economics of intellectual property right and emerging technology is based on cost-benefit ratio of innovation of technology and its adoption. Experience from USA and UK evidenced that the new economic position of market will accelerate the growth of cash crops instead of cereal crops due to more economic incentive inherited in cash crops. It will also promote certain crops which have commercial use. In case of USA some breeders suggested that plant breeding activity in some of the non-hybrid seeds like

soybeans increased after the United States plant variety protection act of 1970.[34]In context to India, stagnation in yield and production is realized in cereal crops during last decade, the cause may be adoption of new biotechnology which promotes commercial crops like cotton and oilseeds. The new IPRs regime in India presented a welcome gesture for multinational seed companies and private sector seed sector to play a role in Indian seed market genetically modified crop technology is new one in India and its impact likely to be analysed at later dates .India has witnessed the GM cotton episode in Gujarat region. There may be chances of more GM crops in other economically valuable crops. Some concerns are expressed that new IPRs and emerging technology will promote low volume high value crops like vegetables and fruits instead of high volume and low value crops like rice and wheat. It is argued that corporatrisation of Indian agriculture may push vanguard crops to back stage in comparison to commercial crops.

It is also argued that the new PVP act will promote breeders to do some greater innovation for development of society as well as get more economic incentives. This will provides new varieties for dry land areas as well as wasteland for horizontal as well as vertical development of Indian agriculture.

4.9.2. IPR and Indian Seed Market

Seed is the most important determinant of agricultural production potential, on which the efficacy of other agriculture inputs is dependent. Seeds of appropriate characteristics are required to meet the demand of diverse agro-climatic conditions and intensive cropping system.[35]The seed sector has made impressive progress over the last three decades .The area under certified seeds has increased from less than 500 hectares in 1962-63 to over 5 Lakhs hectares in 1999-2000.The quantum of quality seed has crossed 100 Lakh quintals.[36]In India most of the farming operation is dependent on farm saved seeds, but it is argued that with the availability of quality seed in the market ,more and

[34] UPOV. Model Law on the Protection of New Varieties of Plants.Geneva 1996.
[35] From National Seed Policy 2002
[36] ibid

more area will be come under quality seeds .This fact is illustrated by the following table of seed replacement rate of some important crops.

Table 4.3. Seed Replacement Rate[37] of Different Crops (Year 2003-04)

Sl. No.	Crop	Seed replacement rate (%)
1.	Wheat	13
2.	Paddy(rice)	19.16
3.	Maize	24.41
4.	Jowar	26.71
5.	Bajra	51.02
6.	Gram	7.09
7.	Urd	20.48
8.	Moong	19.48
9.	Arhar	13.60
10.	Groundnut	5.5
11.	Rapeseed and Mustard	66.96
12.	Soybean	15.58
13.	Sunflower	19.61
14.	Cotton	37.25
15.	Jute	68.49

Source:Annual Report;Department of Agriculture and Cooperation

Ministry of Agriculture(2003-04)

[37] Seed Replacement Rate is the percentage of area sown out of total area of crop planted in the season by using certified/quality seeds other than the farm saved seeds.

On the basis of above table, it may be analysed that the seed replacement rate of wheat and rice is less than rapeseed and mustard and cotton. On the basis of above data, it is argued that the new emerging technology will promote seed industry in the direction of commercial crops instead of vanguard crops.

Most of the Indian seed market is based on the public sector corporation since independence. But after 1980, private sector also entered in Indian seed market. In India organized seed sector is just 4Oyears old and history starts with the foundation of National Seed Corporation in year 1963.V.R.Gadwal(2003) stated that the Indian seed industry is currently valued at Rs.2500 crores ($500 Million) and is proposed to be around 3750 crores ($750 million) by 2002.There are about 150 organized seed companies today[38]. Private R & Ds real investment in research has quadrupled between 1986 and 1998.Subsidiaries and joint ventures with multinational companies accounts for 30 % of all private seed research.[39]

The new act will provide a way for active participation of private sector seed industries in India, it may be analysed from the following table:

Table 4.4. Indian Seed Market

Sl. No.	Sector	1994-95		1997-98		1998-99	
		Market Size (Rs.Million)	Percentage	Market Size (Rs. Million)	Percentage	Market Size (Rs. Million)	Percentage
1.	Public Sector	4000	40	5520	27	5500	25
2.	Organized Private Sector	3500	35	11170	55	13200	60
3.	Unorganized Private Sector	2500	25	3500	18	3300	15
4.	Total	10000		20190		22000	

Source: Ghosh et al 2001.IPR and seed industry, Journal of Intellectual Property Rights,6(2);109-120

[38] Gadwal, V.R. (2003), The Indian Seed Industry: Its history, Current status and future ,current science,vol.84.no.3,10 February 2003.pp399-406

[39] ibid p399

Analysis of above table clearly indicates that private sector seed companies played active role in Indian seed market after trade liberalization and their volume increased immensely. The composition of Indian seed industry has reached a ratio of 60:40 between private and public sector by turnover[40].

There is different opinion on the impact of IPRs on Indian seed market .Some argue that the now monopoly component will give more advantages to private sector companies in comparison to public sector because they are more competitive and having strong research and development infrastructure.

Sidhu (1999) reported that 92 % of wheat farmers are using home grown seed for the next season's crop. This is as high as 92 % for grams and Arhar, 93 % for groundnut and 76 % for rapeseed and mustard[41]. The farm saved seed is the main source of replanting of seeds, but in the new scenario there may be chance of hamper on this aspect .the role of farm saved seed in Indian seed market may be analysed by the following table.

Table 4.5. Indian Seed Market (Quantity in Tones)

Sl No.	Year	Saved Seed	Bought Seed	Total Seed
1.	1998-99	89,53,523	8,64,899	98,18,422
2.	1990-91	51,25,299	5,91,200	57,16,499
3.	Quantity Increase Over 1990-91	38,28,224	2,73,699	41,01,923

Source: (a) The Market for Seed in India; A syndicated Report Based on Secondary Research (1991) by Francis

kanoj

(b)Marketing database, benchmarking the seed market: MAHYCO, 1999.

[40] Chopra, K. R. ,Thimmaiah, K. K. and Chopra, R., Asian Seeds ,95,India:1-12

[41] Sidhu ,M.S.,(1999) Impact of intellectual property rights and agricultural technology :linking the micro and the macro scales ,Indian Journal of agriculture economics,54(3):370-379

On the basis of above table, it is clearly indicated that amount of both saved seed and bought seed is increased between periods of seven years. This is argued that the prospects of Indian farmer will not be hampered due to new IPR regime since majority of framer depends on farm saved seeds. In the changed scenario, farmers are completely free to use farm saved seeds of a protected variety but once he converted into commercial seed seller, he is not permitted to sell the seeds of protected varieties without prior consent and be can be booked for breaching the IPR rules in that case.

Some concerns are also expressed on the basis of impact of IPRs on degree of competition within seed industry, which in turn, determines the prices at which seeds and other planting materials are available to the farmers.

The 1990s have witnessed a spate of mergers and acquisition in Indian seed sectors. The merger and acquisitions may likely to have some impact on Indian seed sector .following table illustrate seed industry merger in India.

Table 4.6. Seed Industry Merger and Acquisitions

Sl. No.	Parent Company	India
1.	Monsanto /Pharmacia	MAHYCO (joint venture for cotton ;26 % share of MAHYCO stock) E.I.D.Parry (Maize, Sorghum and sunflower with Deklab) Cargill
2.	Du Pont (pioneers)	Joint ventures with southern petrochemicals
3.	Aventis (agrEvo, PGS, Nun hems. sunseeds)	Proagro joint venture with PGS in 1998. Agrevo buys Proagro sunseeds
4.	Syngenta	Novartis (was Sandoz)
5.	Empress La Moderna	Seminis

Source:-Bayerlee and Fischer, 2000 "Accessing modern science: policy and institutional option for agricultural biotechnology in developing countries", AKIS discussion paper, World Bank, 2000

The implication of intellectual property protection on seed price is quite unknown; with the most appropriate assumption being an obvious increase in seed price .But it is also argued that this increase in seed prices is compensated by the increase in productivity and increase or relative stability of price.

Available evidences clearly indicates that seed price tend to increase as IPRs are introduced in agriculture. In exercise of the monopoly afforded by IPRs, seed companies seem to develop a tendency to exploit the market by charging higher prices.[42]

4.9.3. IPRs and Crop Productivity

It is argued that the plant breeders develop new plant types, which use fertilizer and other inputs more efficiently, increased pest resistance and were better suited to local growing condition in new regime with more technological input. It is also argued that the new GM Technology will increase the productivity of the crops in vulnerable areas.

4.9.4. IPR and Biodiversity

The issue of IPRs generated a major debate based on environmental factor. the emerging problem of genetic pollution and genetic erosion is sought from several opponents. They argue that the new regime will promote monoculture of specific crop that will create genetic they argue that the new regime will promote monoculture of specific crop that will create genetic erosion and lower down variability within species and varieties.

Walter Reid found a strong connection between IPRs and a bias towards centralized research, which itself has an adverse impact on biodiversity. He argues central research discourage agro ecological research of local breeding to local condition[43].

This is also argued that the GM crop will pollinate the neighbouring crop species and cause genetic pollution.

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[42] Dhar,Bishwajit(2002)
[43] ibid

4.9.5. IPR and Biotechnology

It is argued that the emerging technology involving the manipulation of genetic structure of plants is increasingly becoming relevant to agriculture in new regime. Everyone knows about the bad impact of GM –cotton in India but its second face is totally ignored by the Indian media. The BT –cotton is resistant to American boll worm which cause damage up to 70 % and a very high quality of chemical pesticide is applied for its control. The GM cotton controlled the pest infestation and increased the farmers' prosperity. It is shown that many crops can be developed for varying situations like salinity tolerant rice, drought tolerant rice etc, by using new technology.

4.9.6. IPR and Research and Development in Agricultural Sector

The new IPRs may likely to have some impact on Indian agricultural research and development organization .a situation may arise in which a better collaboration between public and private sector research organization come together to larger benefit .India is a large market of seed and demand can not be fulfilled by single sector .Therefore, it may be predicted that in new liberalized regime private sector seed companies will come forward to actively participate in crop breeding and improvement activities.

The new IPRs regime may create a situation of competition between private and public seed sector, which may lead to give more quality seed to farmers.

Chapter-V

Plant Variety Protection and Farmer's Right Act 2001

5.1. Introduction

Plant Variety Protection and Farmers Right Act 2001 is India's *sui generis* legislation to safeguard the interest of both breeders and farmers. This act was an attempt to satisfy the requirements of all the stakeholders involved in crop improvement and breeding activities. This act also provides the status of farmers as breeders and accepts the farmer's innovation. There are three types of formulation in obligation to fulfill the requirements of TRIPS article 27.3(B) in India's sui generis bill -1.Plant Breeders Right 2.Farmer's Right and 3.Farmer's privilege.

After India became signatory to the Trade Related Aspects of Intellectual Property Rights (TRIPS) in 1994, a legislation was required for the fulfillment of the article under WTO requirement. Article 27.3 (b) of this agreement requires the member countries to provide for protection of plant varieties either by a patent or by an effective sui generis system or by any combination thereof. Thus, the member countries had the choice to frame legislations that suit their own system and India exercised this option. The existing Indian Patent Act, 1970 excluded agriculture and horticultural methods of production from patentability. The sui generis system for protection of plant varieties was developed integrating the rights of breeders, farmers and village communities, and taking care of the concerns for equitable sharing of benefits.[1]

It is argued that Indian legislation takes up the issue of proprietary claims to PGRs through the protection of plant variety and farmer's right bill, which was passed by parliament in the autumn of 2001.The bill, establishes two ways through which proprietary claims to PGRs may be made. First, it creates a system of plant breeders right

[1]Pratibha Brahmi, Sanjeev Saxena and B. S. Dhillon: *The Protection of Plant Varieties and Farmers' Rights Act of India,* Current Science, VOL. 86, NO. 3, 10 February 2004.p392

(PBRs) that confers on the holder exclusive rights of ownership of a plant variety for a specified period. Second, the bill introduces the concept of farmer's right to counter balance breeder's right and address the issue of farmer's proprietary claims to plant varieties.[2]

It is argued that, this act is the result of twin pressure on Indian government, one from emergence of private seed sector and second from the several non-governmental organization (NGO), farmers lobby, and civic bodies. Private sector seed industry emphasised on the introduction of intellectual property protection (IPP) to recognize commercial plant breeder's contribution in the development of new varieties, which was reinforced by the emerging private seed industry in India.

This act is am attempt of government of India to recognize and reward the contribution of both the commercial plant breeders and farmers. It is argued that Indian government wanted to raise the status of science of plant breeding and variety improvement through establishing better relationship between public and private research and development organization and strong symbiotic relationship between farmers and breeders to enhance the productivity of the crop in equitable and sustainable manner to overcome the problems of malnutrition, hunger and food insecurity. This act provides a balanced approach to fulfil the desires of private seed industries, multinational seed companies, and corporate mergers to get high benefit from the market and also by providing norms of seed saving and exchange to farmer to preserve their own social system of seed saving. It is argued that "The Indian law which has been hailed as progressive, pro-developing countries legislation has some notable features, apart from a well defined breeder's right; it has strong and proactive farmer's right. In fact Indian act succeeded in balancing the rights of breeders and farmers and exploited the flexibility granted in TRIPS in an intelligent manner .There are clause to protect the rights of researcher and provisions to protect the public interest."[3]

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[2] Shaila Seshia.; *Plant Variety Protection and Farmers Rights: Law Making And Cultivation of Varietal Control, EPW, VOL 27. JULY6, 2002, p2741-2747-.*

[3] Sahai Suman(2003) India's Plant Variety and Protection Rights Act 2001, ,Current Science Vol.84.No.3.10 February 2003

5.2. History and Genesis of India's Act

The process of drafting the bill lasted more than 10 years and generated a considerable debate and controversy in public domain, political groups and scientific community. The first steps to introduce PVP in India's system begin before TRIPS in the late 1980s under the pressure of private seed sector. First time the draft of India's PVP bill was introduced in year 1993 by Ministry of Agriculture, the nodal department regarding the bill. Three more drafts were proposed in year 1997, 1999, and 2000, but last only two bills are taken in front of India's house.

The bill of 1999 (Bill no.123) "The Protection of Plant Varieties and Farmer's Right Bill 1999" introduced in lower house in December 1999. The bill was subsequently referred to a joint parliamentary committee (JPC) to hold public consultation in order to improve the bill since it was controversial and not found satisfactory. From January to August 2000 ,the JPC held public consultation on the bills at various location throughout India and subsequently tabled its report ,along with a revised draft ,in the lower house on August 25,2000.After almost a decade of development ,the bill was passed by Indian parliament in August 2001 as an Act 52 of 2001. The JPC Consulted each and every stakeholders involved in crop improvement and breeding and also taken care of voices of farmer's lobby ,NGOs, private sector seed industries and different actors interested in debate to give fine tuning of the bill and tried to fulfill the requirements of all the stakeholders.

Plant Breeder's Right (PBR) or Plant Variety Protection (PVP) system is synonymous terms to describe specialized (sui generis) IPR system for cultivated plants.[4] PBRs were first systematized under the International Union for the Protection of New Varieties of Plants (UPOV[5]).

[4] Spillane,charles (2002)
[5] http://www.upov.org

It is argued that discussion involved in proprietary claims to plant varieties and plant genetic resources have emerged in different arenas (principally, through international trade and global environmental regimes). This act is an attempt to satisfy variety of different agreements like UPOV and CBD. Within the trade arenas, the TRIPS agreement represents the most recent regulatory expansion of IPRs in plant varieties. The expansion is occurring in the context of liberalized trade and financial flows in developing countries, Increased private sector agricultural R&D, corporate mergers among agrochemicals and biotech companies ,and growth of the biotech industry[6].

In a sense, this represents the advance in scope and intensity, of process of commercialization and commodification. The need for a global regime of IPR protection for plant varieties through the WTO may be traced to the multinational seed, agro-chemical and biotech companies, virtually all of which are headquartered in developed countries have strong system of PVP[7]. As they expand their operation globally and gain access to markets in developing countries, MNCs seek to secure minimum standard of IPR protection, and so minimize the risk and uncertainty associated with R&D.[8]

As per the lines of TRIPS article 27.3(b), government of India, enacted its effective sui generis bill but the actual meaning of the metaphor "sui generis "is not well defined in actual TRIPS article. It is generally accepted that the UPOV system of PBR would constitute an effective sui generis system. Although India has not yet joined the union but the protection of plant variety and farmers right bill is influenced by the UPOV model of PBR. The UPOV system of PBR is significant because it creates an alternative to patent protection, whereas patent covers inventions and have the generic criteria of non-obviousness, novelty and industrial applicability. PBRs extend to plant varieties only and require that varieties be novel, distinct, uniform and stable.

The term breeder is also in question because in Indian context most of the plant breeding material is conserved and propagated by farmers. The demarcation between

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[6] Correa Carlos M (2000).Trade Related Agenda ,Development and Equity TRADE; Working PaperNo.8,Geneva.South Centre

[7] Sell ,Suman K: Multinational Corporation as agents of change :the globalization of IPR in a Claire et al(eds.) ,private authority and international affarirs.pp169-97,state university of New York, press ,Albny.

[8] ibid

breeder and framer is not clear in many developing countries including rice producing and exporting countries like India, Bangladesh, and Thailand. Because most of the recent varieties are bred and developed by farmer's conserved genetic material.

The International Undertaking on plant genetic resources (IU[9]) and the CBD offers a counterpart to the construction of ownership and control of plant genetic resources in global debates on plant variety protection. The undertaking endorsed the principal that PGRs are the common heritage of humankind and therefore, should be made freely available. This idea provides the discursive basis on which countries and international gene banks were able to amass enormous amounts of plant genetic materials without the consent of, or remuneration to those countries (largely in the south) from which they were obtained. Characterization of PGR as the heritage of humankind mask the fact that they are also a significant strategic natural resources-growing in importance with the development of biotechnology-that are distributed unevenly throughout the world, but concentrated on developing countries.[10]

The IU also points out the asymmetry between breeders, who make claim rewards for the development of new varieties and farmers who helped to develop the genetic material with which breeders work, but whose contribution is unrecognized and unrewarded and provides equal platform to both PBRs as well as framer's right. The IU empowers a farmer to claim benefits arising from the use of PGRs .Hence, it provides proprietary control over varieties similar to the protection offered by plant breeder's right.

The CBD also similar issues those taken up in the IU, with the key difference being that the CBD is binding on its signatories. On the basis of its signatory nature, it is argued that certain provisions of the CBD are believed to provide a legal counterweight to article 27.3 of TRIPS. Article 3 of the CBD affirms the sovereign rights of state to their biological resources and like the IU a convention accept the historic and

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[9] The international undertaking was adopted by the FAO conference in 1983 and though non -binding, it is the first international agreement to address the issues concerning access and proprietary claims to PGRs for food and agriculture.

[10]Hardon et al(2001)

contemporary contribution of local communities to the conservations and cultivation of biodiversity and to the body of knowledge about biodiversity.

Most of the agricultural knowledge and innovation are inherited by informal innovators by means of their culture, practice and folklore. CBD provides reward to the primary conserver of plant genetic resources in the form of benefit sharing, although the CBD recognizes indigenous and local knowledge. It, positions the knowledge holders as beneficiaries of rewards claimed by the others to the extant that, it is compatible with IPRs regime. In both the agreement IU and CBD the right of entitlements of farmers or holders of traditional knowledge, arise largely from their contribution to conservation of biodiversity and improvements they have made to PGRs.

A number of provisions and concepts of TRIPS, UPOV, the IU and CBD are founding pillars and the key elements of Indian legislation; they connect global agreements, treaties and national law making processes. The exclusion of Plant varieties from the scope of patentability under the patent act, 1970 is related to introduction of a separate plant variety protection regimes as part of the commitments taken under article27.3 (b) of the TRIPS agreement.[11] A decision was taken to adopt separate legislation a solution adopted by majority of WTO member states. The resultant plant variety act introduces to new form of protection for plant varieties. First, the plant variety act introduces plant breeder right modeled after the UPOV convention. PBRs constitute historically the compromise response of European states to call for IP protection in agriculture by the seed industry compounded with a widespread unwillingness to introduce life patents. The PV rights are thus a form of intellectual protection meant to provide incentives to commercial breeders. They are conceptually closed to patent rights but differ insofar as the right granted to commercial plant breeders are more circumscribed than under patent laws. Moreover, the plant variety act also introduces farmer's right, these rights which allow farmers to register their varieties largely in the same manner that is provided for commercial plant breeders.

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[11] Shaila Seshia p.2746

The overall impact of PVA is to direct a significant shift of policy towards intellectual property protection in agriculture even though patents are generally not welcomed. This can be compared to the past situation where no intellectual property protection was available in the field of farming sector and where the predominance paradigm was free exchange of genetic material and knowledge among all concerned actors from local to global level. The hypothesis behind granting legal protection to plant varieties is to encourage commercial plant breeders to invest their resources for improving upon the exiting plant varieties thus IPR in plant varieties provide same assurances to breeders that they will be able to recoup the risk and costs of value added innovations, which is based upon an underlying biological resources.[12]

5.3. Rice and Plant Variety Protection Rights and Farmers Right Act

Indo -Burma region is regarded as one of the centre of bio- diversity of rice crop. The genetic resource of rice breeding and improvement is available in third world, which is genetically rich, but resources and technology poor. India has a wide range of varieties of rice suitable for its various agro ecosystems .Most of rice varieties are improved by the selection and domestication of farmers. Actually, farmers are prime conserver and breeder of rice varieties, cultivars and landraces in India. They have provided crop genetic resources for further research to various agricultural R&D organizations. Rice breeding and improvement programme is a typical example of symbiotic relationship between traditional knowledge keepers and international and national breeding organizations. The miracle rice variety I R -8 that heralded the green revolution in India was developed by scientific knowledge of breeders with the help of farmers, who provided genetic material of breeding.

The India's PVP &FR act 2001 might have some direct impact on rice improvement and breeding programme. Most of the Indian rice varieties are developed by Central Rice Research Institute, Cuttock, Orrisa, Directorate of Rice Research Hyderabad and other Rice Research institution are directly linked with continuous effort

[12] Singh , Harbir(2002)

of both the actors. Therefore, it may be predicted that the new PVP and FR act 2001 provide new vistas for rice R&D having more efficient, effective and managed system for farmers or breeders because it accepts both innovations.

This is argued that in the changing pattern of plant science, crop scientist, agronomist and breeder will take more positive efforts for the development of new varieties of rice due to monetary benefit as reward system and equally farmers will harness more economic benefit for the conservation of crop genetic resources. It is also argued that the actual challenge is to take more advantages from TRIPS article in case of vanguard crop like rice. Therefore, India should strengthen his public sector research organization more compatible and more efficient even before in case of rice varietals improvement programme.

It is argued that, there is no always possibility of win-win scenario in rice improvement and breeding programme in context to article 27.3(B) of TRIPS. It seems that the article is tailor made for the profit of industrialized countries or developed countries whose PVP act is already in conformity with TRIPS article. The challenge is in front of developing world countries having no such type of legislation before signing the WTO agreement.The above said article is based on western philosophy of reward system of innovation but it does not recognizes the efforts of informal innovators like farmers. Therefore, NGOs and civil bodies have their argument in disagreement with India's sui generis bill. The fear arises from the notion of monopolization and comodification of vital public good of India by the transnational corporate. The NGOs, civic bodies and concerned activist are not very wrong in their *locus standi* because there are several cases of bio-piracy of natural resources of third world by developing world.

Fear is also expressed about the widening the gap between north and south. The direction of R &D investment in case of agriculture research in the new changing scenario is in suspicion. They continuously argue that the new arena of agriculture research is more devoted to commercial crops instead of cereal crops because more active participation of private sector and TNCs. Most of the private sector seed industries have motive of more income generation by means of over utilization, and exploitation of public good.

This is argued that the Varietal diversification of rice may be fall in peril due to monoculture of selected varieties promoted by emerging technology. More than 1,00,000 varieties of rice were found in Asia early in the 20th century. Today, it has less than a dozen modern varieties being planted in 70% of land cultivated for rice. More than 30,000 of these were found in India where only 10 varieties are grown in 75 % of its land today. Sri Lanka's more than 2000 varieties of rice have been replaced by five modern varieties. In the Philippines, where around 3500 varieties of rice planted in the first half of the 20th century, only eight varieties are grown in more than 75 % of Riceland today.[13] Their argument is not very wrong but there is a limited chance in plant genetic resources, after TRIPS enactment in global scenario. Our food security is also affected by the changing pattern of farming of commercial crops in comparison to cereal crops, because they are more remunerative.

The development of new varieties of rice is need of the time because rice production is at plateau stage. No increase in horizontal component is possible only vertical expansion by means of variety development is possible to maintain the food security of the nation. Development of new Variety is only achieved through the useful and judicious utilization of our natural resources and creative use of new technologies in plant breeding and improvement. Therefore, it may be argued that a holistic approach is needed for the rice improvement and breeding programme.

The new PVP & FA 2001 will likely to have some positive impact on rice improvement and breeding programme. Some NGOs, farmers lobby and political group from left to right have some emotions about conservation of traditional knowledge and heritage. However, outcry against the new technology is not solution of hunger problem. In the new act, it will have to search positive things and use them for our development because science is a dynamic force of social change but it has some consequences also. If one only think about consequence of science than it would results inaction, which makes problem more severe and condition, become bad to worst. Rice is a special case for India and south because it is not stable food for masses in north due to their food habits. India has several varieties of rice suitable for different agro ecosystems and climatic condition

[13] Elenita C .Dano ,Biodiversity ,Biopiracy and Ecological Debt

like upland, lowland, deepwater, wet conditions saline alkaline soil conditions. It has traditional rice varieties suitable for saline soil, salt tolerant and deep-water conditions. The scientific contribution and free movement of plant genetic resources change the scenario from "begging bowl status" to "mountains of cereal grains" in green revolution. The impact of green revolution was not only food security but also national security and national sovereignty .Although green revolution had some geo-political and socio-economic consequences on our society but its positivism is also important. India had witnessed the humiliating days of PL-480, but due to the green revolution technology transfer, diffusion and dissemination bad days were over. The new technology resulted into establishment of new instrument and institution in agricultural R &D. Again due to so advertised genomics revolution, India will have to search new path for development and progress in agriculture. Every disparity come with some opportunity .Planners and economist will have to work for select good opportunity suitable for our condition to harness the actual potential of our farmers and breeders. That is why government of India accepted framers status as breeders by giving them framers right or farmers privilege in act to fulfil the requirements of TRIPS article 27.3(b) and in tuning with other global convention and treaties to promote more raid movement of genetic material with equal opportunity to both the counteracting actors.

India has developed commendable strength and strong position in agricultural research with a wider network of national agricultural research system (NARS) under the guidance of Indian council of agricultural research. All India coordinated rice improvement programme was initiated in the year 1965 to achieve the self-sufficiency and goals of food security by means of development of new rice varieties suitable for various agro climatic zones. Indian breeders working mainly in public sector research system have developed a large number of rice varieties. In the absence of plant breeders right, these varieties would be freely available to others for exploitation and led to example of biopiracy. New varieties of this crop developed based on parental lines could be protected in other countries without any benefit accruing to Indian institution/organization. Whereas, the availability of varieties developed in countries which provides PBR would be restricted in India. Therefore, putting a system of PBRs in

action through Indian legislation would provide protection to the rice varieties developed by public research system. India cannot marginalize the private sector seed industries in its farming system because of its vast arable land. No one agency either public or private can fulfil all the demand of seeds. Therefore, need of public-private collaboration with a suitable approach is India's concern to maintain its food security by providing quality seed to farming community. In absence of PBRs, private sector seed industries and TNCs hesitate to organize buy –back production of seed in India for export to their countries for fear of unauthorized use of their genetic materials.

5.4. Unique Features of the Act

The India's act has so many unique features. It strikes a balance between the rights of farmers and breeders by rewarding the framers and local communities from the pool of natural gene fund for their conservations and development efforts and at the same time, ensuring the rewards for innovation by granting plant breeder's right. Public interest will be taken care of through provisions of compulsory licensing, non-obligation of varieties that effect public order and morality and are injurious to technologies like biotechnology, are not misused, the act prohibits registration of any variety that contains genetic use restriction technology (GURT)[14]. It is hoped that this legislation will stimulate and give positive direction to research and development in agriculture both in public and in private sector by providing protection for plant varieties.

While providing for an effective system of protection of PBRs, the India's act provides a way to safeguard the farmers and researchers right. The framers right includes his traditional right to save, use, share or sell his farm produce of a variety protected under this act provided the sale is not for the purpose of reproduction under a commercial marketing arrangement. Indian farmers are the largest player of seed sector by means of their own arrangement of seed saving and exchange. The seed saving and exchange is not only for agricultural purpose but it has several social and cultural values. In cases of rice, most of the peasants depend on farm saved seeds or exchange of seed material between

[14] Singh, Harbir(2002)

or within the community. Therefore, it may be argued that there is least threat of monopolization of seed market of India.

It also provides a way to facilitate equitable sharing of benefit arising out of the use of plant genetic resources that may accrue to a breeder from the sale disposal etc. of seed or planting material of protected variety. There are provisions of compensation for the village or farming community in case of their traditional or local varieties is used for the development of new varieties.

In other side of ongoing debate, plant breeders are more interested in favour of their interest because it provides a better incentive for their innovation .The India's act aims to provide a better solution for struggle between unequal and an endeavour to provide a model for least developed nations. India is a developing country and since most developing countries have mixed agricultural economies, the use of different instruments to comply with TRIPS obligation will vary in accordance with needs and goals of each sector of their economies.

5.5. Objective of the Act

The main objectives of India's Sui generis act are:

(a)Stimulate investment for R&D both in the public and private sector for the development of new plant varieties by ensuring appropriate returns on such investments ;and

(b) Facilitate the growth of seed industry in the country through domestic and foreign investment, which will ensure the availability of high quality seeds and planting materials to Indian farmer's .PVP and farmer's authority is being set up. And

(c) To provide establishment of an effective system for protection of plant varieties

(d) To provide rights for the farmers and breeders

5.6. Institutional changes

There is a provision for the establishment of Plant variety protection and farmer's right authority, national gene fund, and biodiversity register in this act for the effective implementation and judicious management of our natural resources in IPR regime.

5.6.1. Plant Variety Protection and Farmers Right Authority

This authority has the vital powers to perform all function relating to the protection of plant varieties. The main function of this authority is promotion and development of new varieties, registration of extant and new crop varieties, characterization and documentation of varieties; provide the compulsory licensing of protected varieties and to collect statistics with regard to plant varieties, seeds and gene pool for compilation and publication.

5.6.2. National Gene Fund

National gene fund is proposed to be utilized for supporting conservation and sustainable use of genetic resources including in situ or ex situ conservation of collection of genetic resources. Some allocation may be earmarked for *ex situ* conservation of varieties and maintenance of gene banks. The funds are also to be used for recognizing and rewarding the contributions of farmers engaged in the conservation and enhancement of agro-biodiversity. Individual and community contribution is also recognized and rewarded in this context. In this context, there could be some linkages between the provisions of this act and biodiversity management committee proposed to be established at the panchayat /local body level under the biodiversity act passed recently[15].

[15] Proceedings of MSSRF–FAO Expert Consultation .*Legislation to Action*. M.S. Swaminathan Research Foundation, Chennai, 2002, pp. 176.

5.7. International Context of Plant Breeder Right and Farmer Right

Plant patenting began in year 1930 in united state of America. The 1930 plant patent law allowed for patenting of asexually reproduced cultivars (except tubers).By the 1960s some European countries enacted PBR law. It was demonstrated that sexually reproduced varieties were uniform and stable enough to be included in these laws. The PVP act was enacted in December 24, 1970 in USA, the introduction of this act is very new in India

The enactment of the PVP act in 1970 marked a major shift in American law and policy towards the products of plant breeding. Breeders led the move to evolve PBR as an alternative to the patents(main form of IPRs for industrial innovations)because of political opposition to extending patent protection to plants and legal complexities of defining plant varieties(Ragnekar 1998). PBR may be defined as rewarding system for plant breeders (innovators) for their contribution to society in form of some monetary benefits to accelerate the rate of innovation and make breeders more responsible for society. "If there is no any reward system in plant breeding R & D, no one can disclose his innovation in field of agriculture research for public good."

The PBR was first systematized under the international unions for the protection of new varieties of plants (UPOV[16]).The concept of PBRs first time came into existence due to the convention of 1961. The purpose of UPOV convention is to ensure that the member state acknowledge the achievements of breeders of new plant varieties by making available to them an exclusive property rights ,on the basis of a set of uniform and defined principles. The main purpose of that convention was to provide a new regime for plant protection in comparison to patent system. UPOV is the brainchild of European countries, those wanted to establish a new form of protection in plant instead of American plant patent of 1930. The successful enactment of breeder's right in the Netherlands and Germany accelerated the pace of UPOV. The major difference between 1961 UPOV and plant patent regime is tabulated below:

[16] UPOV is an intergovernmental organization that was established under the 1961 UPOV convention signed by its member governments.

Table 5.1. UPOV 1961 and Plant Patent Regime

UPOV 61	PLANT PATENT REGIME
1. Plant breeders' can obtain protection for discoveries.	1. Patents only for invention.
2. Criteria for protection : 1. Novelty, 2. Distinctness 3. Homogeneity, 4. Stability	2. Criteria for protection: 1. Novelty, 2. Inventive step involved 3. Industrial applicability
3. Forfeiture of rights if a protected variety loses its essential expression of characteristics.	3. No corresponding provision
4. Submitting of propagating materials to the national authority designed for the purpose necessary in most laws.	4. No such requirement
5. Initially covered a small canvass	5. Specified exceptions
6. Flexibility in favour of users (a) Farmers privilege (b) Breeders exemption	6. Rigid application to secure rights to patentee (a) Dilution of farmers privilege (b) Introduction of EDVs to curb research exemption

Source: Dhar, Bishwajit(2002) Sui Generis System for Plant Variety Protection. A discussion paper. Quaker United Nation Office

The UPOV convention extended into force in 1968 and was amended in 1972, 1978 and 1991.It is said that last two amendments were very substantive. The 1991 act of the UPOV convention entered into force on 24th April 1998.Membership of UPOV among other steps, requires the signatories adopts national legislation along the lines of the 1978 or 1991(such as USA). The comparison of the UPOV1978 and UPOV 1991 is presented below in Table no.5.2.

Table: 5.2. Comparison of UPOV 1978 and UPOV 1991

SUBJECT	UPOV 1978	UPOV 1991
Minimum scope of coverage	Increasing number or genera or species is required to be protected from 5 at time of accession to 24 eight years latter	Increasing number of genera or species required to be protected from 15 at time of accession, to all genera and species 10 years later (5 years for member states of earlier UPOV ACT).
Eligibility requirements	Novelty, distinctness, uniformity and stability	Same as in 1978
Minimum exclusive rights in propagating material	Production for purposes of commercial marketing ;offering for sale; marketing; repeated use for the commercial production of another variety	Production or reproduction; conditioning for the purposes of propagation; offering for sale: selling or other marketing; exporting ;importing or stocking for any of these purposes
Minimum exclusive rights in harvested material	No such obligation; except for ornamental plants used for commercial propagating purposes	Same acts as above if harvested material obtained through unauthorized use of propagating materials and if breeder had no reasonable opportunity to exercise his or her right in relation to the propagating material
Prohibition on dual protection with patent	Yes, for some botanical genus or species	No
Breeders exemption	Mandatory, breeders free to use protected variety to develop a new variety	Permissive, but breeding and exploitation of new variety EDVs from earlier variety require right holders authorization
Farmers privilege	Implicitly allowed under the definition of minimum exclusive rights	Allowed at the option of the member state within reasonable limits and subject to safeguarding the legitimate interest of the right holder
Minimum term of protection	18 years for grapevine and trees; 15 years for all other plants.	25 years for grapevines and trees ; 20 years for all other plants.

Source: ; FAO Legislative Study .vol 85,2005

However, India is not a member of the convention, but Indian act also have taken some positive aspects of UPOV. The comparison between Indian PVPFR act and UPOV is presented below in Table No. 5.3.

Table 5.3. Comparison of Indian PVPFR, UPOV 1978 and 1991

SI. No.	Features	UPOV 1978	UPOV1991	Indian PVPFA
1	Minimum scope of coverage	Increasing number of genera or species required to be protected from five at time of accession to 24 years later	Increasing number of genera or species required to be protected from 15 at time accession to all genera and species 10 years later(5)years for member state of earlier UPOV act	All species required to be protected for 15 years.
2	Exception to right(farmer privilege)	This is in practice.	Farmer privilege optional for member state reasonable limits and subject to safeguard the legitimate interest of right holders	This is recognized in the Indian act.
3	Protection period	15 years	20 years	15 years
4	Compulsory licensing	Not defined	Not defined	In case of public interest defined as reasonable availability of seeds of export and marketing
5	Breeder exemption	Mandatory, breeder free to use protected variety to develop a new variety	Permissive, but breeding and exploitation of new variety "essentially driven"	Permissive
6	Protected material	Vegetative and reproductive propagating material, harvested material for commercial use of ornamental	Vegetative and reproductive propagating material, harvested material under particular condition	No material required to be protected; best state must protect sufficient material to grant an IPR.
7	Other requirement	Those imposed by 1978 act.	Those imposed by 1991 act.	These imposed by Indian own act.

Source; FAO Legislative Study .vol. 85, 2005

5.8. PBR Vs Plant Patents

PBRs provide a better alternative to plant patent .PBRs differ from a patent into a number of aspects. Noteworthy, in place of the novelty, non-obviousness and utility requirements of patent law, PBRs uses the requirements of novelty, distinctness, sufficient uniformity and stability(DUS).PBR is better mechanism in plant protection than plant patents because, it provides both research exemption and farmers privilege.

The PBRs were initially adopted only in industrialized countries because of the advance status of their agricultural R& D and most developing countries of third world did not grant PBR because of lack of efficient structure and institution in their system. It became mandatory for developing countries to accept this act after the establishment of TRIPS agreement under WTO umbrella. In initial days, developed world has also confusion about this act. The terminology of "effective sui generis system" is not well defined in TRIPS article, so it led to chaos among member state on the nature of the plant variety protection system that developing countries should adopt to confirm to TRIPS. There were also a large conflict between industry and NGOs and farmers lobby about the nature of *modus operandi* of act. Industry wanted to the provision in UPOV 1991 act to be founding principles of TRIPS. However, due to vociferous protest from NGOs and farmers lobby worldwide prevented an interpretation of the sui generis clause as UPOV.

5.9. Debate on Farmer's Right

This right accept the status of informal innovators like farmers in the generation of new crop varieties .Farmer's right is the reward system for them because it recognizes the contribution of gene rich resource poor innovators for their contribution in new development of new cultivars of crops . Dr. Swaminathan defined it-

"Farmer's right stem from the contribution of farms, women and men and rural and tribal farmers to the creation, exchange and knowledge of genetic and species diversity of value in plant breeding".[17]

[17] Swaminathan (1994)

The emergence of farmer's right internationally as a political idea in the mid 1980 marked a radical departure from industrial world convention and an assertion of the importance of folk varieties and indigenous farmers.[18] The free access basis of farmer's right in FAO undertaking was later modified as a concession to the dominance of the industrial world system of private property making farmers right more palatable to industrial country farmers.

Since 1987, the promotion of farmer's right has been the major international efforts regarding IPR and folk varieties and was endorsed in 1981 and 1991 as part of the FAO undertaking.[19]

The FAO defines farmer right as "right arising from the past, present and future contribution of farmers in conserving, improving, and making available plant genetic resources, particularly those in the centres of origin and diversity. The rights are vested in the international community, as trustee for present and future generation of farmers, for the purpose of ensuring full benefit of farmers and supporting the continuation of their contribution".

Such broad statement of farmers right with values reflecting as indigenous view point have been strongly resisted by many industrial country governments and private seed and biotechnology companies. However, the mechanism that has been emphasized so far is a general fund for third world agriculture, which would likely be similar to existing agricultural research and development organization that would result if any change in reorganization of the results of indigenous farmers as defined by them. The 1994 agreement transferring jurisdiction over the large collection of folk varieties and other crop genetic resources in the gene banks of the CGIARs international research centers to the FAO means that that the FAO's determination of what contribute farmers right and its negotiation with the CGIAR centers whose gene banks continues the house the collection take on much greater significance.

[18] Fowler (1994)
[19] ibid

A farmer's right fund has been established at the FAO into which industrial countries and seed companies could contribute a fraction of a percent of the profit from sales of modern varieties, but few contributions has been made.[20]

In the developing countries of south, farmers are a main source of seed supply and a large amount of seed requirements are met through their own mechanism of community exchange of seed and farm saved seeds. Farmers to farmer exchange of seed not provided only seed sovereignty and food security but also strengthened their symbiotic relationship between farmers themselves and society and also with a "nature." There are threes basic aspects of farmers right—1.Farmers privileage2.Benefit sharing and 3.Farmers right as ownership.

5.9.1. Farmer's privilege

Originally, plant breeder's right under UPOV was only for commercial production and marketing and since the use and exchange of seeds was considered outside the scope of PBR. Therefore, UPOV 1961 also provided way for farmer's privilege but not commercial sale of seeds. In the letter year of 1991, UPOV revision the farmer's exemption was reduced to an oppositional clause leaving it to states to decide on the extant of farmer's right to save and exchange of seeds.

5.9.2. Benefit Sharing

The concept of benefit sharing emerged after the convention of CBD in year 1992 and led to shift in viewing genetic resources not as common heritage but rather as the sovereign rights of nation. Benefit sharing refers to compensation to farmer's or communities who contribute to the creation of new variety for the development and conservation of existing varieties. The most vital aspects of this were to acceptance of farmer's roles for their contribution of agricultural growth and development by their own mechanism of conservation of nature and natural resources.

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[20] Posey (1974)

5.9.3. Farmers Right as Ownership

The contribution of the farmers in maintenance preservation, conservation of crop genetic material is old as agriculture. The history of agriculture is 10,000 years old but history of plant breeding is 200 years old. Therefore, it may be strongly argued that most of the existing varieties are the result of domestication and natural selection of landraces done by farmers and communities. However, reorganization of this is fairly resented over the past decade as so a vast body of literature has been generated, particularly in response to the global initiative at prescribing in conserving biodiversity and role of the indigenous people in these conservation activities.

5.9.3.1. The Formal Innovation vs. Non-Formal Innovation in Context to Farmer's Right

The farmer innovation process in which farmers adopt clearly defined criteria to identify the improve varieties, they developed has a certain resemblance to that followed by formal plant breeders, the latter relay on the three fold criteria of distinctiveness, uniformity and stability of the plant varieties. They develop to lay to PBRs but similar farmer innovation received no recognisation or reward. The recognisation that formal plant breeder received is facilitated by the extensive certification of knowledge. The lack of such codification lies at the heart of the relative neglect of the contribution that farmer have made.[21] The nature of farmer innovation process is also different with the formal process of innovation. Breeders conduct its research under controlled condition the farmer uses the available environmental condition to conduct his experiment[22].

Furthermore, farmer use of environmental condition based on detailed knowledge of environment in which they practices their farming. The natural selection occurs with the action of environmental stress on inherent variation caused by gene recombination and mutation. Wright and Turner (1955) pointed out that diversification in the local gene

[21] Dhar ,Bishwajit(2002)
[22] Ibid p5

pool is primarily a function of farmer abandonment of varieties and rapid change within varieties is only likely if mutation is only likely, if a mutation has a strong competitive advantage or if it is actively selected or multiplied.

Various studies have argued that the formal system of research has a distinct rich farmer bias and result of the vast multitude of poor farmers in most developing countries are able to benefit from the advance in farmers technology. This bias could be rectified according to Harwood by involving farmers in research at all levels and stages and sharing credit of results .Farmer right is vital to change the direction of agricultural innovation for the fulfilment of needs of farmer and their societies. Similar fact is suggested by chamber and Jiggins .According to them the main locus of research and learning is the resources poor farmer rather than the research laboratories. this approach wherein the resource poor farmer(RPF) themselves identify priority research issues in according to chamber and Jiggins, based on respect for confidence in the ability to resources poor families to tell scientist their understanding of the problems they face and to identify how the formal research system help them.[23]

The coexistence of both the PBRs and farmers right may provide better research agenda in agricultural sector because it provides a better relationship between farmers and breeders. A series of case studies conducted since the early1980s have put farmer innovation in perspective. Many labels have been used to describe this. Farmer back to farmer, farmer first and last Farmer participating research among others studies have tried to document in the key role that the farmer could play in the selection of appropriate variety for commercial exploitation. It is argued that no any agriculture extension programme and farm innovation can get success without the active participation of farming community. Government of India initiated its lab to land or land to lab programme with this holistic approach in year 1979 to accommodate farming community in extension programme. Recognisation of farmer contribution in the new varieties of crops in turn provides the way for advancement of agriculture in developing world. This fact is realized by both the national and global policymakers.

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[23] chamber, Robert and Janice Jiggins "Agricultural research for Resources poor Farmers :A Parsimonious Paradigm," IDS Disscussion Paper No. 220,August 1986

Countries representing third world like India, Africa and Latin America had strong informal innovation system in case of agriculture and rural development .Most of their crop cultivars are continuous selection of farmers. Therefore, developing countries are trying to create or created the administrative structure that would be necessary to mainstream the farmer contribution and are taking necessary legislative action.

One of the first such efforts has been made by India by enacting the plant varieties and farmers right act. Similar attempt is done by Thailand in its act, Bangladesh is also moving in positive direction. The organization of African unity also developed model legislation for the protection of rights of farmers and breeders as well as other local communities, which Namibia has drafted into its draft law. National and regional initiative have complemented international efforts for the recognisation of farmers right first proposed in 1989.The international treaty on PGR food and agriculture has succeeded in developing a broad consensus or various aspects of managing plant genetic resources. This makes a significant step and should serve as a signal for a larger cross section of developing countries to take legislative action that can protect the rights of farmers.

It is said that the ideology of IPRs is to promote innovation through providing incentive for investing in R&D. In the case of ownership, rights applied to farmer's varieties, in addition to promoting innovation for farm maintenance of diversity. There is also a parallel aim of collecting payment of past innovation and natural conservation practices. Therefore, the genesis of farmer's right is correct in a way to empowerment of rural masses of the third world both legally and socially by means of these instruments.

Developing countries in the FAO passed a resolution in 1989 that led to the birth of farmers right TRIPS mentioned that unique system of IPR in plant protection system .TRIPS does not provide only hindrance for farmer's right because it is on state to interpret the article in most efficient and equitable manners, which fit to their own socioeconomic and political systems .so, there is also scope for farmer's right.

5.10. Indian Policy Regarding Plant Breeder Rights and Farmer's right

Various policy analysts argued that the genesis of India's Sui generis system has based on common heritage-as the principle of free exchange of crop germplasm based on a view that major food plants of the world are a part of common gene pool. A focus on ensuring access to technology and promoting economical development, India did establish IPR laws to protect the rights of innovators but attempt to balance this with need for access to resources at reasonable price. A majority of agricultural research in India has largely been conducted by the public sector research organization. India's seed policy 1980s restricted the role of private sector seed in agriculture. However, 1988 seed policy recognized the role of private sector and new seed policy 2002 accepted the several norms of plant varieties and farmer right act.

The emerging role of private sector in India led to the path for demand for PBR in India. The seed association of India (SAI) formed in 1985 first actively promoted the need for PBR in India. In 1989, it organised a seminar that brought together counter acting actors at same platform from the ministry and seed industry to emphasize the need for IPR with the conclusion of article27.3 (b) of TRIPS agreement.[24] There was also external pressure for India to establish PBRs in India. The seminar recommended---

"Time is ripe for introducing plant breeders right in India in order to further strengthen crop improvement and to provide better quality seeds to farmers, considering various alternative for protection of rights consumes emerged in favours of PBRs as a adopted by UPOV convention."

The private sector demand for PBR led to the public sector and government to initiate study and discussion of IPRs in agriculture. Previously the public sector had objected to PBRs, partly because it would unable private companies to take advantages of breeding material developed by public sector. The ICAR pointed out that with the commencement of new seed development policy in 1988, deliberation for undertaking legislation in terms of PBR/PVP and gene patenting where initiated at the instance of private sector who wanted legislation for protecting their rights on plant.

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[24] Shaila Seshia(2002)

The FAO report about "desirability and feasibility" suggested that India should formulate the PBRs in accordance to UPOV, but should also recognizes farmers right .The ICAR subcommittee recommended PBR for hybrid in India and noticed that if it was provided for other varieties the farmer's right to save seed must be protected.

As was the case with plant breeder right attention to broad structural condition establish the backdrop against farmer's right was asserted. At the rational level India's liberalizing the reforms in 1990s were felt in the agriculture sector through removal of fertilizer subsidies and other forms of agricultural support. The globally the draft final act of Uruguay round or Dunkel draft of which TRIPS is one part ,was proposed to resolve deadlock in the Uruguay round negotiation in late 1991.The timing of India's SAP reforms and Dunkel draft is significant for just as India's agriculture sector was undergoing structural change the draft promised further liberalization among other things ,the removal of quantitative restrictions(QRs),the reduction of agriculture support and phasing out of non –tariff trade barriers.

Enormous protest against implementing TRIPS, and introducing PBRs, arose from NGOs and farmers lobbies in India. Biopiracy of the traditional knowledge is the major danger raised by the NGOs and activist in India, Vandana Shiva one of the most prominent activist, articulated the issue as—"western IPR system are dramatically opposed to indigenous knowledge system. PBR negates the contribution of third world farmers as breeders and hence undermines farmers right patent allows the usurpation of indigenous knowledge as a western invention through minor tinkering and trivial translation[25]" (www.vshiva.net).

Vandana Shiva again asserted, "New IPR laws are creating monopolies over seed and plant genetic resources .seed saving ands seed exchange, basic freedom of framers are being redefined". She is also against the GURT technology. Vandana Shiva argued in opposition of terminator technology "this termination of germination is means for capital accumulation and market expansion". NGOs in India were able to effectively promote their view through events at the international level. The sovereign rights concept of CBD

[25] www.vshiva.net

in 1992 and issue of farmer's right within the FAO and other forum was another factor in shaping the debate. She also argued about a new form of License Police Raj in seed sector. It is argued by several activist and political ecologist that the new biotechnology may create danger for the survival of natural fauna and flora. According to Shiva, genetic engineering will pollute our age-old traditional landraces and varieties.

NGOs in India argued that Sui generis clause in TRIPS could be utilized to formulate a unique system in India that upholds Farmer's right. NGOS developed alternate such as community rights[26] and demanded that India must be paid for use of genetic resources and their must be formal recognisation of farmers varieties.

5.11. Types of Varieties Protected Under the Act

The main importance of this act is the provision to obtain IPP over varieties through a system of registration. This act also defined the variety. According to this act variety is defined A plant grouping except micro organisms within a single botanical taxon of the lowest known rank, which can be (a) defined by the expression of the characteristics resulting from a given genotype of a plant of that plant grouping;(b) distinguished from any other plant grouping by expression of at least one of the said characteristics; and(c)considered as a unit with regards to its suitability for being propagated ,which remains unchanged after such propagation and include propagating material of such variety, extant variety ,transgenic variety, farmers variety and essentially derived variety.

Section 14, 23 and 29 of the act specifies the range of plant variety that can be protected. The act provides the regulation for the registration of four types of varieties: new variety extant variety, essentially derived variety and farmer's variety. The definition, criteria, right granted and term of protection of all the four varieties as elaborated in the act are complied below in Table5.4.

[26] Vandana Shiva emphasized on it.

Table 5.4. Varieties Protected Under India's PVPFR Act.

TYPE	DEFINITION	CRITERIA	RIGHT GRANTED	DURATION
New Variety	Variety means a plant grouping except microorganisms defined by certain characteristics under the act. It is new if it meets criteria.	Novelty Distinctness Uniformity Stability	Exclusive rights to breeder to produce, sell market, distribute .import or export the variety.	Initially 9 years up to total of 18 years for trees and vines .Initially 6 years renewable up of 15 for other crops
Extant variety	A variety available in India which is notified under section 5 of the seeds act 1966:or a variety about which there is a common knowledge ;or any other variety which is in the public domain	Distinctness Uniformity Stability As specified under this regulation	Exclusive rights to produce, sell, market, distribute. import or export the variety if claimed by the breeder and in case where not claimed by the breeder the central government or state government shall have the right	15 years from the date of notification of that variety by the central government under section 5 of the seeds act,a966
Farmers variety	A variety which has been traditionally cultivated and evolved by the farmers in their fields: or is a wild relative or land races of a variety which the farmers posses the common knowledge	Unclear if distinctness, uniformity and suitability would be the criteria or not	unclear	unclear
Essentially derived variety	A variety predominantly derived from such initial variety that itself is predominately derived from such initial variety ,while retaining the expression of essential characteristics that result from the genotype or combination of genotypes of such initial variety ;is clearly distinguished from such initial variety ;and conforms(except for the difference which result from deprivation)to such initial variety in the	Genera or species specified by the central government and test to determine if it is an EDV	Same rights as a breeder of a new variety provided that the authorization by the breeder of the initial variety to the breeder of essentially derived variety may be subject to terms mutually agreed upon by both the parties	Initially 9 years renewable up to total of 18 years for trees and vines. Initially 6 years renewable up to total of 15 years for other crops.

	expression of the essential characteristics that result from the genotype or combination of genotypes of such initial variety			

Source:-adapted from" The Protection of Plant Varieties and Farmers Right Act 2001",act no.52 of 2001)New

Delhi; Alkanak publications.

The act also provides a legal way for the registration of and variety, provided the claimer fulfil all the regulation regarding the registration of act. Further illustration of above is as following:

5.11.1. New Variety

Protection of new varieties is the type of right demanded by breeders and generally refers to varieties protected under existing plant breeder's right system. The criteria for the new varieties in India's act are borrowed largely from the UPOV and it would be mainly private sector breeders who could apply for protection of their innovations.

5.11.2. Essentially Derived Variety

The concept of essentially derived variety first emerged when UPOV was revised in 1991.in India's legislation; the concept is modified to suit certain interests. It provides greater protection by providing the scope of initial breeder is right to varieties that are essentially derived from the protected variety. The provision of the EDV is adopted in India's act for the protection of varieties held by the public sector. It is also ironic to note that the some NGO are also favouring it in spite of the fact that it is made for more benefits of breeders. Dr. M. S.Swaminathan also favoured EDV and argued, "We should include in the essentially derived concept the parent genetic material contributed by rural

and tribal men and women"[27], although the concept was not included in the draft produced by the Swaminathan foundation.

5.11.3. Extant Variety

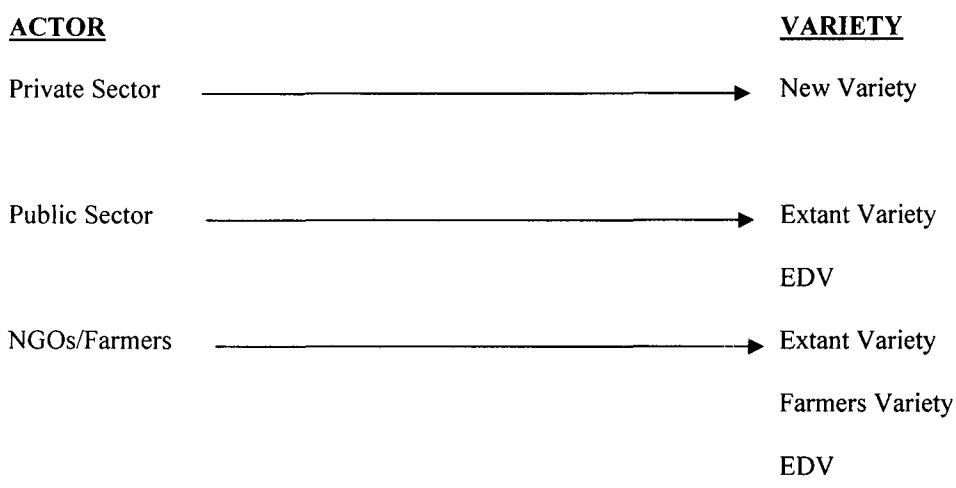
Protection for the extant varieties is a new criteria not found anywhere in the world. This is an attempt to further extend protection to extending varieties rather for newly developed innovations. .Economic and social commission for Asia and pacific 2010 favoured India's notion of extant variety and appreciated that the provision for granting protection to extant varieties does not have a parallel in history and does not fit into the theoretical framework governing IPP.

5.11.4. Farmer's variety

India's act created a history by accepting the norms of farmer's varieties and it defined farmer in the context of changing global economy. farmer may be defined as any person (a) cultivates crop by cultivating himself or (b) cultivates crop by directly supervising the cultivation of crops through any other person or(c) conserves and preserves, severally or jointly, with any person any wild species or traditional varieties or adds value to such wild species or traditional varieties through selection and identification of their useful properties. The provision of farmer's variety in the act is an instrument to satisfy the interests of NGOs and farmers lobbies who demanded that farmers should be treated on par with breeders and allowed to register their varieties. This also provides a way for the accepting the communities right in case of crop genetic resources. A diagram is given below to show the likely benefits to actors from various types of protection.

[27]Swaminathan(1994)

Fig. 5.1. Likely Benefits to Actors from Various Types of Protection



Source: Ramanna Anitha, EPTD Discussion Paper on India's PVPFR Legislation.

5.12. Impact Of PVPFR 2001 on Various Actor Involved in Varietal Development and Improvement Programme

Public sector, private sector and farmers are the different actors involved in variety development of crops. This is a vary early time to asses the real impact of new act and it is also difficult task but due to inception of this act may have some impact on them due to changing pattern of exchange of genetic material between various actors. In case of green revolution, flow of resources was multidirectional but in new genomic technology, it might have restricted flow of resources.

One school of thought points to increase in access to the best and recently bred foreign varieties with the extension of PBRs in developing countries. The logic is that MNCs would introduce new varieties in India with the protection afforded by IPR against coping of their material, but it depends upon several other factors. The exchange of material between public sector and organizations like CGIAR and international agricultural research center may change due to this act. However, India's public sector institution would have the ability to charge for the use of material that could be registered under the act. Since CGIAR centers currently operate based on free exchange, there may arises greater incentives to transfer of materials between actors who would pay for the

resources rather than to the international agricultural centre. This would also depend to some extent on the implementation of FAO's recently concluded treaty on PGR .India could also charge for exchange betweens countries that do not go through the CG system. Foreign actors would also be able to register their varieties in India and encourage for use.

There might have also some impact on exchange of genetic material between public and private sector in view of this new act. Under India's system public sector freely exchanged the material to the private sector with the capacity to protect both the new varieties and extant varieties under the act there could be certain changes of this practice of free exchange. In this case, the small sector seed industries cannot get the genetic materials due to unaffordable payment for genetic material but large-scale companies may take benefit.

There may be some impact on exchange between public sector and farmers. The public sector institution in India transfer many seeds and varieties to farmers and this constitute an important system of free exchange. Under the new regime, if the public sector finds it can earn more revenue from the private sector for use of its varieties, it may rather charge for use of its varieties from the private sector rather than giving it away freely to farmers.

The farmer-to-farmer exchange of the seed is common practice in Indian agriculture. The farming community by means of their age-old traditional culture and practice of exchange of seed and planting material between or beyond the communities plays a greater role in India's seed market. "over 85% of the seeds requirement amounting to roughly 52 lakhs tones, that are planted in India every year are supplied by the farming community"[28].The Indian act also provides the way for exchange of genetic material between the communities if it is not sold as the branded seed.

The direct exchange between farmers to farmers may also be mediated by a new actor –NGO-in the system. It is not yet clear what would be the impact of NGOs on

[28] Sahai , Suman

exchange of plant genetic resources between the stakeholders. However, it is important to note that they would play a significant role in a new regime.

5.13. Protection of Interest of the Commons

The new act includes the public interest clause like exclusion of certain varieties from protection and grant of compulsory licensing. To secure public interest, certain varieties may not be registered if it is felt that prevention of commercial exploitation of such variety necessary to protect order of public moraality.[29]It also provides researcher rights.

Chapter 8 of this act provides an instrument to give priority to the public interest over the interest of commercial breeders by granting compulsory licensing. The act provides for the granting of compulsory license to a party other than the holder of the breeders, certificate if it is shown that the reasonable requirements of the public for seeds have not been satisfied or that the seed of the variety is not available to the public at a reasonable price. The breeder may be ordered by the authority to grant a compulsory license under certain terms and conditions including the payment of a reasonable license fee. A compulsory license however will not be awarded if the breeder can demonstrate reasonable grounds for his inability to produce the seed.[30]

Section 30 of the act provides the norms for researchers right which grant them to get free exchange of genetic material from the authority but repeated use of the provided material is restricted and it is granted by the breeders if found useful for better purpose but not for commercial exploitation.

5.14. Impact of act on Documentation of Traditional knowledge

Traditional knowledge digital network is established for the documentation of traditional knowledge and bio diversity. Documentation process is not easy due to lack of

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[29] Brahmi, Pratibha et al.
[30] ibid

literacy among our rural people and also efficient mechanism and authority responsible for the documentation and compilation of data. India has largest collection of rice gene pool in its tribal areas like Jeypore tract of Orrisa and Raipur collection in Chatishgarh.

There are no reliable estimates of the total contribution of traditional crop varieties (landraces) to the global economy. However, a study on the use and value of landraces for rice breeding in India calculated that rice landraces acquired from India and overseas contributed 5.6%, or $75 millions to rice yields.[31]

This is very early time to asses its impact on documentation and registration process by several stakeholders. However, some stakeholders asserted their rights on their innovation. The process of documenting bio-wealth of India is getting momentum day by day. NGOs, government organization and public sector institution already started documentation[32] and registration of their innovation. The documentation process is vital for securing some protection through either plant variety or farmers right protection. India government also started maintaining data for patent application filed in India by means of patent facilitating centre (TIFAC).Table 5.5..provides list for the number of patent application filed in India on some vital agricultural commodities.

Table 5.5. Patent Application Related to Specific Agricultural Commodities, January 1995-June 2000

Commodity	Number of applications
Rice	60
Cotton	51
Neem	47
Wheat	6
Sunflower	2
Tomato	4
Maize	4
Cauliflower	1
Sugarcane	14
Corn	5

Source-TIFAC(1998 updated 2001)Database on Patent Application filled in India

[31] Evan son ,RE, "economic valuation of biodiversity for agriculture"
[32] see annexure

The national innovation foundation and Sristhi database also provides some references found to three products: neem, rice and cotton. The references are tabulated below:

Table 5.6. Some References of Agricultural Commodity

Serial Number	Commodity	No. of Entries
1	Neem	95
2	Rice	105
3	Cotton	94

Source; sristhi database

Chapter – VI

Conclusion

"In the end, it is human choice and not the content of science that determines the outcome. The content of science can only enhance or potentiate choices rooted in social and ethical values." .....Stephan Jay Gould

"Blending traditional and frontier technologies lead to the birth of ecotechnologies with combined strength in economics, equity, employment and energy."

.....M. S. Swaminathan

Cultivated crops like rice are part of Indian rich heritage and tradition. Without paying thrust on it, developing world economy may collapse. There is danger from people having litigious mind set who wish to make a public good into private. Active participation of both farmers and breeders with equal rights and opportunity may provide an effective tool for the conservation of natural resources as well as promotion of breeding activities. Up to some extant, The PVPFR act 2001 seems to fulfil this aspect because it provides both PBR and farmers right.

There is proverb that says "give a man a fish and he is fed for a day, teach a man to fish and he is fed for life". Therefore, there is need to educate commons about their genetic stocks and provide them adequate and efficient policy instruments and institution for registration and documentation, so no one can make plunder and usurpation of their traditional knowledge. A "genetic literacy campaign" is a need of time among farming communities especially in tribal communities. The concept of "bare foot legal advisor" should be promoted in tribal areas. "patent literacy campaign" is equally important.

The scientist, plant breeders, policymakers and civic bodies in the centre of origin of rice such as South and Southeast Asia need to work with local communities so that improving traditional cultivars become a potential option through intervention such as participatory plant breeding approach. Supporting such action coupled with identification of markets for such varieties is sure to enhance the value of genetic diversity on which future generation can make proud.

There is also a burning question in front of our planners about maintaining food security of the nation. The past technology shown its failure to fulfil the demand of our population, so emerging technology is the only mechanism seems to fulfil the gap between demand and supply. The emerging technologies may serve the people and fulfil the needs and provide ends, if it is applied with appropriate regulatory mechanism. Further increase in rice production is possible only through application, adoption, dissemination and diffusion of new technologies such as biotechnology and improved agronomic facilities like new irrigation technology, complemented by traditional farming system need to be adapted to changing environment and needs of local people.

The new act is not the only solution of all the problems. There is also need of setting up of efficient and effective institution to maintain the genetic resources. Government has already taken some positive efforts like setting up of traditional digital knowledge network (TKDL) and bio-reserves concept. Thus 'in situ' and 'ex situ' both types of conservation mechanism should be adopted and promoted for the conservation of bio-resources.

In the new era of globalization, the overall challenge on rice based agricultural economy like India is to identify and execute synergetic solution for rice development, and these are possible only when decision makers, policy makers, technicians, farmers lobby ,civil societies and NGO activists are well aware of multiple factors related to sustainable rice production and management. There is also requirement of sound policies on rice variety development and agro-biodiversity management, which is based on the harmonization of diverse policy instruments, which are often under the auspices of different ministries. Having PVPFR is good instrument but there is further need of synergies between instruments such as the International Treaty on Plant Genetic

Resources for Food and Agriculture (ITPGRFA), CBD's programme of work on biodiversity, TRIPS, the principle and excess of benefit sharing are a few of such policies that need better national and regional integration to make rice cultivations relevant for future time.

The adoption of new technology seems promising in rice breeding but it also creates several challenges which includes expanding the base of the beneficiaries of technology, minimizing the risk associated with adoption of new technology for socioeconomic system at various level industry to environment as well as various actors, misuse and overexploitation of third worlds genetic resources for privatization of information and knowledge, impacts of regional as well as trans-boundaries trade on such products, linkages to emerging concept of nano technology and public good. The issues is too complex, because lack of strong competence. Therefore, capacity building among scientific communities and farming community is equally important.

Worshiping and welcoming the new technology is good but equally important is to the continuing the old practices with new blend so traditional knowledge may get recognisation and acceptance. There is also need of a strong extension system for farmers so they may get acquainted with new technology. Framers participatory approach from breeding to policy formulation should given major thrust so they may know the problems of future and take active participation in search of solution.

In the choices of problems for research, it is oblivious that one should select those that defy solution through already available technological tradition. Solving a problem like food security is the goal rather than worshiping the tool like biotechnology and equally raising vociferous opposition to new technology.

In case of agricultural research, public –private collaboration is need of time, because no one sector is able to fulfil the all the requirement of demand of seeds in India. Government of India also had taken a positive step with the new seed policy integrating positive elements of PVP & FR act. There is also need to give more thrust on vanguard crop like rice, because this may be marginalized by the private sector research organization.

This is also cleared from the study that most of traditional varieties are low yielder but they are suitable for particular environment and also provides genes for tolerance of particular insect, pest and diseases as well as specific condition of soil .The positive trait genes from traditional varieties may provide genetic stock to new varieties having more yield enriched with character of old varieties. Therefore, a comprehensive approach is needed in framing of new breeding technology provided equal thrust on both genomics and traditional knowledge and the priorities of research must be concentrated on location specific variety development programme to expand the rice cultivation both horizontally as well as vertically.

The budgetary allocation to public sector organization in rice improvement and breeding programme must be increased so they can compete with private sector and multinational corporate. It is also cleared from the study that the major drawback in developing world is lack of strong public institution and trained regulators. In case of BT-Cotton, up to some extant GEAC proved its inefficiency so there is need to give more thrust on the organization like that and give more autonomy so it can play strong monitoring role.

Equity, poverty alleviation and hunger eradication are the major societal goals and objectives of scientific research and all public system are required to respond these. Experience from green revolution indicated that technological change did contribute to these goals through rise in employment, household income and nutritional status, improved the food security of small and marginal section of farming communities through adoption of high input responsive technology. Up to some extant, new PVPFR act seems to fulfil the entire requirement because concept of equity is fulfilled by the farmer's right.

It is also clear from the study that the home of crop genetic resources is third world but ironic condition is that their plant breeding science and capabilities do not at par with developed world. To address the problem, they must demand increased support from international board of plant genetic resources (IBPGR) in Rome and crop specific IARCs. The need is for greater distribution of germplasm for evaluation, documentation and registration and the development of active breeder's gene bank in two-third of the

developing nation lacking such institutions. A strong, efficient and effective public sector in crop improvement and breeding is the best antidote for transitional seed corporate.

The universities and research and development organization of plant breeding must expand their training and extension facilities to make it suitable with new IPR regime. In the new IPR regime documentation of natural resources is very vital.

There is need of core collection to be developed in India at local, regional and national level for crop species with a large collection such as rice. Germplasm collection expedition should be organized in tribal belts of Jharkhand, Chatishgarh and Orrisa regularly to bridge the gaps in germplasm collection from under explored and unexplored centres of diversity. It is also clear from study that there is need to re-orient the direction of plant breeding research to improve and sustain genetic biodiversity and maintenance of economical and beneficial genetical traits. Biotechnological tools like, DNA finger printing and gene mapping should be used for release varieties/elite breeding lines to analyze genetic diversity in the collection and marker-assisted selection.

It is also revealed from the study that in era of intellectual property rights, a breeders consent is required for repeated use of a specific genetic trait in the improvement and development of new cultivar of rice so future rice breeding programme will need more secretarial, legal and paper work as well as more work in lab and land. Capacity building with well equipped laboratories and trained technical experts is need of time. Human resources development is vital for both germplasm rich and technology rich segments.

In context to analysis of TRIPS article 27.3(b), there is also ambiguity of the word effective Sui generis .The agreement failed to define exact meaning of effective sui generis so it offers a flexibility to developing world nation to adopt a PVP system which suit their interest to the fullest extent. There is also a need of mature debate on issues of identifying sources and countries of origin of genetic resources through the CBD and WIPO through debate on access and benefit sharing are bound to make issues of patenting and IPR protection more realistic and supportive of local needs.

Development of national accessions system and organization; careful management of seed gene banks, establishment of more gene banks in areas of centre of origin is one of the promising solution of bio-piracy of resources in India. There is also need for augmentation and conservation of rice agro- biodiversity under both 'ex situ' and 'in situ' farm conditions.

It is also concluded from the present study that it is easier to estimate the cost of technology rather than the intrinsic and predictable value of genetic resources. Quantification of traditional knowledge and agro –biodiversity is tough task. Therefore, one of the major issues in coming days in rice development programme is the correct valuation of the ingredients and techniques in breeding in order to fix price tag on products and subsequently to share commercial benefits on an equitable basis.

To make rice variety development more realistic and fruitful to the society, a better knowledge is needed of the morphological as well genetical architect of rice crop, population, buffering, target gene incorporation and gene pyramiding. It is also vital to give major emphasis on IPR and informed consent should be sought in advance for genetic modification and to guarantee biosafety and bio security.

There is also need to give more thrust on demand specific market oriented research as well suitable for different agro ecologies.

The investment in self pollinated crops like rice is not likely to flow from the private sector seed companies as farmers can save, exchange and reuse the seed as per likely farmer's privilege provision of IPR in developing countries .However, this will not be a general phenomenon when hybrid rice and genetic modified rice come into market. Therefore, the public sector research organization will have to invest much more in future in vanguard crops. This is also required to build capability in public sector organization to negotiate, promote and deliver private-public partnership in an environment where biotechnology for biosecurity can be considered public good. A networking and consotorium of scientific institution, R & D organization, and policy building bodies will be extremely important in coming days in IPR regime. They may be public-public, public-private, or private-private, operate at various levels and capitalize on

complementarities and harness synergies at all levels. This would be one of the best ways of developing cost effective rice varieties and hybrids.

There is also cleared from the study that countries of third world must increase their efforts to achieve greater international harmonization of existing laws in plant breeding and biodiversity, rules and practices. There is also cleared from the study that developing country may assert more tactical move in WTO summits and ministerial conferences to make more effective instruments, which may suit to their needs. as per the lines most of the developed world favoured sui generis system like plant variety protection and farmers right having more liberal and progressive look rather than patent. TRIPS article 27.3(B) is still under review so if developing countries make solidarity at their ranks, they may able to bargain more from developed world. The demand of TRIPS plus ethics is good approach as R.A. Mashelkar suggested in this direction. Therefore, a united and effective effort from third world is required to make the article more conducive to their condition.

All developing country like India need to determine, design and reframe IP policies and rules suitable to their needs and level of development of crop biosecurity and management of genetic resources.

There is need to recognize the innate genetic potential of traditional varieties that continue to grow in stress specific environments and enhancing their productivity level are as important as supporting technological intervention in breaking potential of rice crops. Promotion, development, identification and documentation of such varieties with appropriate mechanism such as framers right will be critical for ensuring continued engagement of resources poor farmers in rice cultivation.

There is also clear from the study that the issue of geographical appellation in rice is likely to become more important in India because it has traditional and environmentally specific varieties having different location specific taste, colour , size , aroma, flavour, nutritious ability, stickiness and softness and consumer preferences depends on the location and market. A possible consideration of such agricultural goods in the review process of TRIPS for special protection under GI is likely to emphatically

bring in this new element in the IPR protection portfolio that the future rice breeding and improvement programme may not ignore. India may emphasize for extension of GI norms beyond wines and sprit to include the natural resources like basmati rice, Darjeeling tea and litchi from Bihar. The concept of plant patent is very new innovation in third world, so it is still very early to come on clear and concrete conclusion.

In the analysis and discussion of study many question have emerged. Some of which have been attempted to answer and some may have been left due to constraints of time and space. They require further empirical study.

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APPENDIX-I

History of IPR System

SL NO.	YEAR	Origin Place and References
1.	500 B.C.	Italy
2.	1500-1600AD	England
3.	1800-1900ad	Europe and USA (Modern Patent Legislation System)
4.	1930	Plant Patent System in USA
5.	1970	Plant Variety Protection Act in USA
6.	2001	Plant Variety Protection and Farmers Right Act

Source: self generated on the basis of Dr Pranav N. Desai's Paper on IPR

APPENDIX – II

Time Line of the Global History of Patent

Sl. No.	Year	References
1	1200	10 year monopolies granted in Venice, Italy to inventors of silk making device
2.	1449	First recorded patent granted in England for a glass-making process. first patent statute passed
3.	1624	Statute of monopolies issued in England
4	1790	First American patent statute passed
5.	1791	First French patent statute passed
6.	1880-82	Patent statute introduced in most European countries.
7.	1883	Paris convention for the protection of industrial property
8.	1947	International patent institute established at the Hague
10.	1970	Patent cooperation treaty signed in Washington D.C.
11.	1978	International patent institute integrated into the European patent office
12.	1979	Bayh-Dole act passed-granted permission to U.S. universities to license and profit from federal research
13.	1980	International patent documentation centre (INPADOC) integrated into the EPO.

APPENDIX No. - III

HISTORY OF INDIAN PATENT SYSTEM

SL NO.	YEAR	REFERANCES
1	1856	THE ACT VI ON PROECTION OF INVENTIONS BASED ON THE BRITISH PATENT LAW,PATENT TERM WAS 14 YEARS
2	1859	THE ACT MODIFIED AS ACT XV:PATENT MONOPOLIES CALLED EXCLUSIVE RIGHTS PRIVILLAGES,PATENT TERM IS FOR 14 YEARS
3.	1872	THE PATENT AND DESIGN PROTECTION ACT
4.	1883	THE PROTECTION OF INVENTION ACT
5.	1888	CONSOLIDATED AS THE INVENTION AND DESIGN ACT
6.	1911	THE INDIAN PATENT AND DESIGN ACT
7.	1972	THE PATENT ACT (ACT 39 OF 1970) CAME INTO FORCE ON 20TH APRIL 1972.
8	1999	ON MARCH 26, 1999 PATENTS (AMENDMENT) ACT,(1999)CAME INTO FORCE FROM 01-01-1995.
9.	2002	THE PATENT (AMENDMENT) ACT2002 CAME INTO FORCE FROM 20TH MAY 2003.
10	2005	THE PATENT (AMENDMENT)ACT 2005

APPENDIX - IV

Documentation of genetic resources/traditional knowledge

Activity and Year Launched	Agency	Description
National Biodiversity and Strategy Action Plan, 1999	Ministry of Environment and Forests, UNDP, Kalpraviksh and Biotech Consortium India Limited	Assessment and stocktaking of biodiversity-related information at national, local and state levels
National Innovation Foundation, 2000	Department of Science and Technology and IIM, Ahmedabad	Register and support grassroots innovations
Biodiversity Plan	Government of Karnataka	State laws regarding biodiversity
Biodiversity Plan	Government of Kerala	State laws regarding biodiversity
Mission Mode Project on Collection, Documentation and Validation of indigenous technical knowledge	Indian Council of Agricultural Research	Documentation and registration of traditional knowledge
Traditional Knowledge Digital Library	Council of Scientific and Industrial Research	International Library on traditional knowledge
People's Biodiversity Registers, 1995	Foundation for Revitalization of Local Health Traditions	Records the status, uses and management of living resources
Honeybee Network, 1996	Sristi	Document innovative practices of farmers/artisans
Database	Swaminathan Foundation	Document contributions of tribal groups for securing benefits
Documentation	Research Foundation, Green Foundation, Gene Campaign	Documenting and collecting traditional knowledge/resources

Village Registry, 1997	Pattuvam Village, Kerala	Produced a registry of genetic resources within their village and declared it their property

Source: Compiled from various sources including: www.sristi.org, Gadgil et al, "New Meanings for Old Knowledge: The People's Biodiversiy Registers Programme, paper for Ecological Applications; Government of India, 2000, National Biodiversity Strategy and Action Plan: Guidelines and Concept Papers; Government of Karnataka, Biodiversity Plan.

APPENDIX - V

Resources under documentation

Program	Resources Being Documented	Area
National Biodiversity and Strategy Plan	Distribution of endemic and endangered species, site specific threats and pressures, social/political/economic issues, ethical concerns, and ongoing conservation initiatives by various sections of society.	20 local-level action plans, 30 state-level plans, 10 inter-state eco-regional plans, 13 national thematic plans, all of these building in to an overview national plan, but also remaining independent action plans.
National Innovation Foundation	Grassroots innovations	Not specified
Peoples Biodiversity Register	Documents folk ecological knowledge and wisdom through decentralized institutions of governance, and with the help of local level educational institutions.	First initiative: 24 sites covering 10 states, second phase: 10 sites in 4 states, third phase: 56 sites in 7 states, 75 plant biodiversity registers covering 10 states of India produced by mid 1998.
Sristi	Surveyed about 4500 villages and documented more than 10,000 innovations related to agriculture, livestock health and management, farm implements and machinery, poultry keeping, leather tanning, herbal medicine, vegetable dye, etc.	As of 1996, 5376 innovative practices (from about 3500 farmers and artisans of about 2300 villages) had been documented. Currently there are about 8,000 innovations and about 10,000 practices that have been recorded. Database on medicinal plants of about 256 plants found and locally used by farmers.

Source: Compiled from various sources including: www.sristi.org, Gadgil et al, "New Meanings for Old Knowledge: The People's Biodiversiy Registers Programme, paper for Ecological Applications; Government of India, 2000, National Biodiversity Strategy and Action Plan: Guidelines and Concept Papers; Government of Karnataka, Biodiversity Plan.