FEASIBILITY STUDY

FOR

IMPLEMENTING AN IDENTITY PRESERVATION SYSTEM FOR HANDLING LIVING MODIFIED ORGANISMS (LMOs) IN INDIA

UNEP/GEF supported Phase II
Capacity Building Project on Biosafety

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Feasibility Study for Implementing an Identity Preservation System for Handling Living Modified Organisms (LMOs) in India

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ACRONYMS/ABBREVIATIONS

(AFLPs)	**Amplified fragment length polymorphisms**
(AICRPS)	**All India Coordinated Research Project on Soybean**
(AIREA)	**All India Rice Exporters Association**
(APEDA)	**Agricultural and Processed Food Products Export Development Authority**
(APMCs)	**Agricultural Marketing Committees**
(BEDF)	**Basmati Export Development Foundation**
(CBD)	**Convention on Biological Diversity**
(COP-MOP)	**Conference of Parties serving as Meeting of Parties**
(COP-MOP 3)	**Conference of Parties serving as Meeting of Parties- Meeting held during 13-17 March 2006**
(CPB)	**Cartagena Protocol on Biosafety**
(CSDS)	**Centre for the Study of Developing Societies**
(EU)	**European Union**
(FFP)	**LMOs for Food Feed and Processing**
(GEF)	**Global Environment Facility**
(GIPSA)	**Grain Inspection Packers and Stockyards Administration**
(GM)	**Genetically Modified**
(GMOs)	**Genetically Modified Organisms**
(ICCP)	**Intergovernmental Committee for the Cartagena Protocol**
(IGTC)	**International Grain Trade Coalition**
(IISR)	**ICAR-Indian Institute of Soybean Research**
(IMSCS)	**Indian Minimum Seeds Certifications Standards**
(IP)	**Identity Preservation**
(ISO)	**International Organization for Standardization**
(ISTA)	**International Seed Testing Association**
(ITC)	**ITC Agro-Tech Ltd**
(KVKs)	**Krishi Vigyan Kendras**
(LMOs)	**Living Modified Organisms**
(LMOs-FFP)	**LMOs intended for direct use as food or feed, or for processing**
(MoEF&CC)	**Ministry of Environment, Forest and Climate Change**
(NABL)	**National Accreditation Board for Testing and Calibration Laboratories**
(NSC)	**National Seeds' Corporation**
(PCR)	**Polymerase Chain Reaction**
(SFCI)	**State Farms' Corporation of India**
(SOPA)	**Soybean Oil Producers Association**
(SOPs)	**Standard Operating Procedures**
(SSCs)	**State Seeds' Corporation**
(SSLPs)	**Simple sequence length polymorphisms**
(SVBPUAT)	**Sardar Vallabh Bhai Patel University of Agriculture & Technology**
(UNEP)	**United Nations Environment Program**

EXECUTIVE SUMMARY

A system of management and trade practices in agriculture that allows identification of the source and the nature of materials at each stage as the material moves through a series of supply chain starting from purchase of certified seeds through cultivation, harvesting, transfer, processing and packaging for consumption covers the purview of identity preservation (IP). Identity preserved agricultural commodities are often labeled. Interest of IP in trade emanates from private and public desire to establish traceability for value added agricultural commodities. The study is limited to understanding the steps involved in deploying IP for Living Modified Organisms (LMOs) in agriculture and additional measures required for its effective implementation in Indian context. LMOs are defined as living organisms that possess novel combination of genetic materials obtained through the use of modern biotechnology. Genetically Modified Organisms (GMOs) and LMOs are used interchangeably as both GMOs and LMOs are products of modern biotechnology.

The Cartagena Protocol on Biosafety (CPB), a multilateral agreement negotiated under the Convention on Biological Diversity (CBD), also requires proper handling, identification and documentation during transboundary movement of LMOs. CPB was specifically negotiated under CBD with a view to ensure safe transfer, handing and use of LMOs. LMOs covered under the Protocol include LMOs for intentional introduction into the environment; LMOs intended for direct use as food or feed, or for processing (LMOs-FFP); and LMOs for contained use. IP and labeling for LMOs and LMOs- FFP became most important international agricultural trade issues requiring IP and labeling of LMO consignments in the context of Article 18 2(a) of CPB. In the document of CPB, there are no limits specified for the presence of LMOs FFP in LMO or non-LMO consignment. Moreover, in LMO consignments, there is no requirement of assessing about the quantitative presence of different LMOs in consignments, when multiple LMOs are present. Therefore, in the trade and transboundary movement of LMOs, the documentation requirements (especially the “may contain” language in the documentation for LMO-FFPs) have been intensely discussed among Parties and non-Parties to CPB in several meetings of the Conference of the Parties serving as the Meeting of the Parties (COP-MOP) to evolve a unanimous “accompanying document” format. However this situation could not be resolved and after several round of discussions, it was agreed in COP-MOP 3 to continue with the “may contain” language in the documentation accompanying consignments containing LMOs that are not subjected to identity preservation

systems. For new LMOs-FFP consignments emanating from identity preservation processes, the documentation should indicate that the consignment "contains" LMOs and also provide the identity of LMO(s) with the understanding that a final view on this would be taken based on experience gained in the use of IP for LMOs in agriculture. This situation remains status quo.

Genetically Modified crops (GM crops) were developed for increasing the productivity of certain crops in agriculture. For many other such crops, the properties of their metabolic products, in terms of unique quality traits components were improved. Worldwide 26 GM crops incorporating various traits have been approved for commercial cultivation. In India, only one GM crop namely Bt-cotton has been approved and presently more than 90% of the area under cotton cultivation has been used for cultivating this crop. The introduction of Bt cotton has resulted in India becoming the largest producer of cotton in the world. Research in India in other GM crops is intense and work in more than 20 plants with varying traits is in progress; it is expected that several such crops shall be introduced in future in Indian agriculture.

All GM crops are introduced into the environment after extensive study of environmental and food safety from their use. Yet the issues of safety are not fully resolved in the minds of certain sections of the society. Moreover, people wish to exercise their "rights to choose" while selecting agricultural products and packaged foods for their use. Consequently, several countries are instituting labeling laws that require segregation and identification of LMOs and packaged food products.

India has also legislated in May 2012 (effective from 1st January 2013) its laws requiring labeling of packaged food. This law is also expected to be extended to package LMOs as food, feed and processing purposes. However, this law has not yet been enacted in GM products such as GM Cotton Seed oil, GM Soybean oil, GM Canola oil and GM Cotton Seed meal as there are issues of identification and need for clarification on how to implement the statutory requirement.

While experience with Identity Preservation for GM crops is limited; it is already practiced for value-added non-GM crops in several parts of the world including in India in various ways. In most cases, such products are also labeled and branded. In case of GM crops, IP measures are not in place for many countries including USA. However, because of public demand, most countries are taking steps to institute IP measures and to label them. Several countries have already enacted laws for labeling packaged GM products including India. However, in Indian context, since presently there is only Bt Cotton which is authorized for cultivation, IP measures for cultivation of GM crops is not in place although Bt Cotton seeds are truthfully labeled as per the provisions of the Indian Seeds Act and Indian Seed Certification procedures.

A study was carried out to understand the feasibility of introducing IP in India by selecting Soybean and Basmati rice. Soybean was selected to understand what measures are required to be taken to institute IP procedures and labeling for export of non-GM soybean and products thereof as no GM Soybean is being cultivated in the country; basmati rice was selected on the premises that India is a leading exporter of this non-GM commodity and therefore in case international buyers require a certification from Indian exporters about the absence of GM traits,what were the status of preparedness in the country in terms of infrastructure and capabilities. The studies revealed that the managerial expertise, the scientific capabilities and the infrastructure exist within the country and the trade in both the cases can be supplemented with the necessary certification of GM status where required.

The requirements for implementing an IP system for LMOs in India have been analyzed. These include setting up procedures and protocols for procurement and planting of certified seeds; agricultural fields; field isolation to be maintained; cleanliness of equipment and requirement of storage facility; sampling and testing procedures; record maintenance and labeling protocols; as also procedures for third party auditing. All these factors are attainable and doable in India for LMOs. However, institution and implementation of these measures would require incurring of substantial costs. The benefits of value-added crops can be captured if the buyers are ready to pay for the increased added costs. Since the main driving force for introducing GM crops and processed GM foods is to reduce the price and be benefited from the lower cost of production of GM crops, it is to be ascertained if the incurred incremental cost of establishing IP in such products would be affordable from within the incremental benefits of cost of production of such products.

Indian agricultural output is essentially from marginal, small and medium land holders. The profession is leaned more towards subsistence and towards increasing income than towards business. Bt Cotton technology is the only GM technology that has been adopted in India. Use of Bt Cotton seeds in cultivation resulted in increase in farmer's income by 83% over non-Bt cotton. Further, Bt Cotton cultivation generated more labor employment than non-Bt Cotton with female labors becoming major beneficiaries among the casual workers who were hired in preference to male workers, for both planting and cotton picking. Adoption of Bt Cotton technology resulted in increased yield between 30-40% and reduced insecticide quantities by about 50% on an average, thus generating substantial additional income. Except for the Bt Cotton seeds which are identity preserved and labeled in accordance with Indian laws, no other products in the value chain such as Bt Cotton seed oil and Bt Cotton seed cake are either identity preserved or labeled.

Based on the literature data, it has been calculated that introduction of a robust IP system would lead to increase in the prices of LMO grains when cultivated, from 6% to 17% more than the farm gate prices of such commodities without having to implement IP and labelling. Such additional costs seem to be substantial and may not justify imposition of statutory IP system and labelling.

The study has revealed that identity preservation measures of LMOs in India would lead to sizeable cost increase of the cultivated products. As regards labelling LMOs, among the two labelling policies such as statutory labelling policy and voluntary labelling policy of GM crops, it is suggested that the voluntary labelling policy would be more appropriate for implementation in Indian conditions. This would however raise protests from vocal public who would demand compulsory labelling of LMOs. The labelling policy and the identity preservation procedures can be framed by creating a rational balance between and among the interests of the small & medium farmers and the vocal public seeking to demand compulsory labelling of LMOs.

CHAPTER 1
INTRODUCTION

1.1 WHAT IS IDENTITY PRESERVATION?

A system of management and trade practices in agriculture that allows identification of the source and the nature of materials at each stage as the material moves through a series of supply chain starting from sowing of seeds to harvesting and processing by use of standard operating procedures (SOPs) adopted at each stage from purchase of quality seeds to cultivation, handling, harvesting and processing for marketing that establishes the maintenance of purity and integrity of agricultural commodities through documentation are acts within the purview of identity preservation(IP). Interest of IP in trade emanates from private and public desire to establish traceability for value added agricultural commodities. Even though enforcement of IP increases added costs in production and logistics, the market is ready to offer higher prices for identity preserved agricultural commodities because of guaranteed value-added traits. Value added agricultural commodities are becoming more and more demand oriented, which are driving forces for recognition of benefits of supply chain management where specialty grains that are identity preserved[1,2] would pass from grower to processor to ensure delivery of quality final products.

The introduction of genetically modified (GM) crops in 1990s to improve agricultural productivity contributed to reduction in production costs of several crops but brought out controversies especially by international environmental groups emphasizing the idea that GM crops are not safe to human or the environment. This has led to the world community to believe that GM labeling would benefit consumers, besides would satisfy individual's rights to choose GM food. Accordingly, the concept of IP has become relevant for GM crops.

[1]Sundstrom FJ et. al, Identity Preservation of Agricultural Commodities, Agricultural Biotechnology in California Series, 2002, http://anrcatalog.ucdavis.edu/pdf/8077.pdf)

[2] Smyth S et. al, Product differentiation alternatives: identity preservation, segregation, and traceability. AgBioForum, 2002, 5(2), 30-42, http://agbioforum.org/v5n2/v5n2a01-smyth.htm

1.2 CARTAGENA PROTOCOL ON BIOSAFETY

The Cartagena Protocol on Biosafety (CPB)[3], a multilateral agreement negotiated under the Convention on Biological Diversity (CBD)[4], also requires proper handling, identification and documentation during transboundary movement of living modified organisms (LMOs). ALMO is defined in the CPB as any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology. Genetically Modified Organisms (GMOs) and Living Modified Organisms (LMOs) are used interchangeably as both GMOs and LMOs are products of modern biotechnology. Categories of LMOs covered under the Protocol include:

- LMOs for intentional introduction into the environment (e.g. seeds, live fish)
- LMOs intended for direct use as food or feed, or for processing (LMOs-FFP) (e.g. agricultural commodities- corn, canola, cotton)
- LMOs for contained use (e.g. bacteria for laboratory/scientific experiments)

Article 18 of the Cartagena Protocol on Biosafety specifically spells out the requirements for the handling, transport, packaging and identification of LMOs. These include “specified set of documentation according to the intended use of LMOs” which has implications on the identity preservation requirements during the transboundary movement of LMOs. While the documentation requirements for LMOs for contained use and intentional introduction into the environment requires a clear identification of the LMO including common and scientific name, relevant trade and genetic modification including transgenic trait and characteristics such as events of transformation, the requirements for LMOs-FFP have been a subject of intense debate. In view of divergent opinion among Parties, a series of discussion were held on the documentation requirements under the aegis of Conference of Parties serving as Meeting of Parties (COP-MOP), which serves as the governing body for the implementation of CPB. In the COP-MOP3 held in Curitiba, Brazil in 2006, it was agreed that with respect to documentation accompanying LMOs-FFP, the following may be mentioned:

a) In cases where the identity of the LMOs is known through means such as identity preservation systems; that the shipment **contains** LMOs-FFP
b) In cases where the identity of the LMOs is not known through means such as identity preservation systems; that the shipment **may contain** one or more

[3] Cartagena Protocol on Biosafety, Montreal, 2000, https://www.cbd.int/doc/legal/cartagena-protocol-en.pdf
[4] Convention on Biological Diversity, United Nations, Nairobi 1992, https://www.cbd.int/doc/legal/cbd-en.pdf

LMOs-FFP

The scenario in (a) is likely to apply where LMOs are segregated and if any mixing occurs, the composition of the mixture is precisely known. The scenario (b) on the other hand is likely to apply to LMOs originating from countries where GM and non-GM organisms are grown without segregation and therefore co-mingling is likely to occur both during growing and/or storage and marketing. It was indicated that even in the latter case, the likely components of the mix should still be known, though the exact proportions may not be known. This is important particularly with respect to whether these LMOs are approved or growing for marketing in the country. Therefore, in both the scenarios, the identity of LMOs contained or that may be contained have to be specified.

Following the decisions in COP-MOP3, several parties to CPB initiated discussions on documentation requirements for LMOs-FFP including feasibility of implementing IP systems for LMOs in their countries.

India is a Party to CPB since 2003 and is committed to meet its obligations. Ministry of Environment, Forest and Climate Change (MoEF&CC) is the nodal Ministry for implementation of CPB in India. MoEF&CC is also responsible for biosafety regulatory framework for GMOs/LMOs in India through the Rules [5] for the manufacture, use, import, export & storage of hazardous microorganisms, genetically engineered organisms or cells, 1989 notified under the Environment (Protection) Act[6], 1986. MoEF&CC is engaged in capacity building initiatives through national and international resources to strengthen the implementation of biosafety regulations in the country.

In this context, MoEF&CC is implementing[7,8] Phase II Capacity Building Project on Biosafety supported by the United Nations Environment Program (UNEP)/Global Environment Facility (GEF). The project has four thrust areas viz. Risk Assessment and Risk Management, Handling, transport, packaging and identification (HTPI) of LMOs, Socio-economic considerations and enhancing public awareness. As part of the HTPI component, MoEF&CC through M/s Sompradip Publishers & Consultants

[5] Rules for the manufacture, use, import, export & storage of hazardous microorganisms, genetically engineered organisms or cells, 1989, http://envfor.nic.in/legis/hsm/hsm3.html
[6] Environment (Protection) Act, 1986, http://envfor.nic.in/legis/env/env1.html
[7] Phase II Capacity Building Project on Biosafety, http://www.moef.nic.in/division/unep-gef-supported-%E2%80%9Ccapacity-building-project-biosafety%E2%80%9D-phase-ii
[8] Phase II Capacity Building Project on Biosafety Project Brief, http://in.biosafetyclearinghouse.net/publication/project_brief.pdf

has undertaken a feasibility study to assess the present status, strengths and weaknesses of the identity preservation system of LMOs. The focus of the Phase II capacity building project is on LMOs in agriculture and hence the present study is confined to GE plants (also referred as GM crops in the text).

The terms of reference of the study included review of existing IP systems for various commodities in India, particularly soybean and rice, international IP systems available for LMOs and evaluating the feasibility of implementing IP system for LMOs in India.

1.3 METHODOLOGY ADOPTED

The study has been undertaken by a combination of literature survey, internet search, interaction with relevant stakeholders and field visits. In addition, the status of obligations under the Article 18 of the CPB has been studied taking into account the negotiations so far. The status of identity preservation of LMOs in different countries was also studied including the experience of release of Bt cotton in India. Issues such as low-levelpresence, adventitious presence and possibility of coexistence of LMOs with non-LMOs were also studied with respect to their implication on feasibility of identity preservation for LMOs. Visits were undertaken to two important “Mandis” (wholesale marketplace), one dealing with Soybean and the other with Basmati Rice. Discussions were held with the officials of Soybean Oil Producers Association (SOPA) in Indore and All India Rice Exporters Association (AIREA).Units where processing Soybeanand Rice were visited and discussions held with stakeholders in the supply chain to study how IP is maintained through the processing operation. A large Basmati Rice processing unit was also visited and discussions held with the processors.

The draft report was discussed with resource persons familiar with issues related to GMOs/LMOs. The final report includes the following:

- Need of Identity Preservation of LMOs in India and other countries
- Cartagena Protocol on Biosafety &Article18
- Status of IP for LMOs in different countries
- IP SYSTEMS IN INDIA FOR SOYBEAN AND BASMATI RICE
- Status of Indian agriculture and preparedness for identity preservation of agricultural crops

- Feasibility of IP System in LMOsin India

The conclusions of the study relate to feasibility of implementation of IP systems in India are based on the present status of activities related to LMOs in the country. The study is limited to understanding the steps involved in deploying IP for LMOs in agriculture and additional measures required for its effective implementation.

CHAPTER 2
IDENTITY PRESERVATION IN THE CONTEXT OF LMOs

2.1 IDENTITY PRESERVATION (IP) FOR AGRICULTURAL COMMODITIES

Identity preservation (IP) of agricultural commodities refers to the systems and practices of tracking the details of bulk commodities, the identity of unique characteristics that are systematically preserved through records and practices. The exercise is followed for bulk commodities marketed in a manner that isolates and preserves the identity of consignments. Identity preserved bulk agricultural commodities are segregated to prevent co-mingling during normal storage, handling and shipping procedures.

IP practices are generally followed for commercial gains. IP is also linked to comply with the labeling requirements. To obtain value from IP, different kinds of labeling practices have been followed in different countries for various agricultural commodities. Labeling is used to provide stakeholders with information that is valuable to them such as data on food ingredients, nutrients composition, calories etc. as per regulatory requirements.

The notion of IP practices hovers around the belief that the product for which IP is practiced has a commercial value and that the various stakeholders would be benefitted from IP implementation and documentation practices to make their choice to distinguish such products from less valuable commodities. IP practitioners implement systems to preserve particular traits and credence attributes to their products. In doing so, they need to implement traceability practices for business logistics purposes and often through compulsions required under various regulatory regimens such as authentication of seeds, food safety regulations when the product is a food etc. IP practices in agricultural commodities usually integrate attributes of specific traits and credence that are important to carry out business for commercial gains. These include economic aspects of a trait for a farmer, for a processor or for the consumers. Farmers while buying seeds are interested in knowing about harvest yield, stress tolerance properties (if any), pesticide usage pattern and the methods of farming. The grain processors and storage outfits are interested to know about the color and keeping quality of the products along with information about whether the grains are genetically modified or not. The processors on the other hand may be interested to know about carbohydrates, oil and protein contents as also the shelf life of the produce. The end consumers are interested in food ingredients, nutrients composition, calories etc. IP practices also require third party verification to ensure content and credence attributes. In many such cases, the regulatory authorities require the practitioners of IP to substantiate their claims through mandatory systems of analysis including traceability analyzing systems.

To capture the values for the 'unique traits', special crop varieties require identity preservation programs to channel these commodities to specific markets to capture the "added value". For example, in organic farming, commodities must be produced according to specific criteria and segregated in the marketplace in order to receive premium prices. In crops with improved traits also, segregation and identity preservation is essential to claim for premium prices[9]**.**

Over the years, as seed and food industries developed in different countries, the quality and purity expectations of buyers and processors increased and as a consequence standards were developed and established. As agricultural commodities start with the seeds which are the most important starting materials signifying the genetic traits, several seed certifying agencies got created with time in different countries that played role in maintaining seed-purity standards and levels established by the industry for national and international trade. Concomitantly, the commodity traders, marketing organizations and food processors established purity and quality tolerances for specific end-product uses. With time, as crops and agricultural production systems diversified to meet the growing market demand, the need for segregation and identify preservation of agricultural commodities had increased.

[9] The Organic & Non-GMO Report, 2007,http://www.nongmoreport.com/articles/mar07/identity_preservation.php

2.2 DEVELOPMENT AND STATUS OF GM CROPS

With the introduction of rDNA technology, GM crops have been developed to incorporate various traits such as insect/pest resistance, herbicide tolerance, disease resistance, altered nutritional profile, enhanced storage life etc. for a range of benefits such as:

- higher crop productivity due to reduced loss to pests and diseases
- reduction in farm costs and thereby increase in farm profit
- general improvement in health and environment due to availability of nutritionally enhanced food
- reduced use of pesticides/ insecticides in the environment which would further reduce the fuel consumption and also led to preservation of natural resources like soil and water due to decreased tillage
- improved weed control due to use of herbicide resistant genetically engineered (GE) plants

The development and commercialization of GM cropshas helped in increasing the productivity of certain crops. For many others, the properties of metabolic products in such GM-plants, in terms of chemical constituents and components have improved in unique quality traits such as increase in the content of unsaturated fatty acids in the oil extracted from such GM-crops or the fruits that have better keeping qualities , and the likes[10]. The status of cultivation and use of GM crops globally and in India is as under.

2.2.1 Global Status

Worldwide 26 GM crops**11′12′13′14′15′16′**[17] incorporating various traits have been approved for commercial cultivation up to date. These include 340 events in such plant species. Many of these are being cultivated widely as provided below in **Table**

[10] Brookes et. al, GM crops: global socio-economic and environmental impacts 1996- 2012, 2014, http://www.pgeconomics.co.uk/pdf/2014globalimpactstudyfinalreport.pdf
[11] Biosafety Clearing House, Convention on Biological Diversity, Frequently Asked Questions about GE Plants (Brochure), http://bch.cbd.int/database/attachment/?id=16570
[12] Huang J et. al, Plant Biotechnology in China, Science 25 Jan 2002: Vol. 295, Issue 5555, pp. 674-676, http://science.sciencemag.org/content/295/5555/674
[13] Which foods in China are genetically modified, https://gmoanswers.com/ask/which-foods-china-are-genetically-modified
[14] List of genetically modified crops. (2017, September 3). In Wikipedia, The Free Encyclopedia, https://en.wikipedia.org/w/index.php?title=List_of_genetically_modified_crops&oldid=798791958, accessed on September 25, 2017
[15] Type of Approval: Cultivation - domestic or non-domestic use- 340 events, ISAAA, http://www.isaaa.org/gmapprovaldatabase/advsearch/default.asp?CropID=Any&TraitTypeID=Any&DeveloperID=Any&CountryID=Any&ApprovalTypeID=3
[16] GM Crops List, ISAAA, http://www.isaaa.org/gmapprovaldatabase/cropslist/default.asp
[17] Bt Cotton aproval in Myanmar, http://www.isaaa.org/gmapprovaldatabase/event/default.asp?EventID=84

2.1. Some of these GM crops/ plants approved for cultivation have not yet been actually cultivated though these have been approved **(Table 2.1).**

Table 2.1: GE plants, traits/uses and countries where and when approved for use

S. No.	GE Plants	Traits/Uses	Countries where approved, when approved-with Remarks
	Alfalfa	Herbicide tolerance/ Animal feed	USA (2005). Approval initially withdrawn in 2007 and then reapproved in 2011. Nearly 862,000 hectares grown in USA in 2014
	Apple	Anti-bruising and delayed browning	USA (2015), Canada (2015). In either of these countries, the plants are not grown
	Bean	Viral disease resistance	Brazil (2011), has not yet been cultivated commercially.
	Canola	Herbicide tolerance and improved protection against weeds	Australia (2003), 3,42,000 hectares grown in 2014; Canada (1995), as cooking oil, 1996 as high laurate canola, 8,00,000 hectares in 2014; Chile (2007), 2000 hectares in 2014; USA(1994), as high laurate canola and 1998 as phytase production variety, 6,85,00 in 2014
	Carnation	Modified flower color and herbicide tolerance	Australia (1995), delayed senescence variety and modified colour) Columbia (2000), modified flower color, small hectare grown in green house for flower export; EU (1998), two events expired in 2008 and another approved in 2007, small acreage grown; Malaysia (2012), small acreage; Norway (1997), modified flower color and 1998, delayed senescence, small acreage; Japan (2004), modified flower color, small acreage
	Chicory	Herbicide tolerance properties	USA (1997), has not yet been cultivated commercially.
	Cotton	Improved insect protection, herbicide tolerance and improved protection against weeds. Products are cotton fibre, cotton seed oil and cotton cake as animal feed	Argentina (1998), 530,000 hectares grown in 2014; Australia(2003), 342,000 hectares grown in 2014; Brazil(2005), 600,000 hectares grown in 2014; Burkina Faso (2009), 454,124 hectares grown in 2014; China(1997), 3,90,0000 hectares grown in 2014; Costa Rica (2008), 36.3 hectares grown in

S. No.	GE Plants	Traits/Uses	Countries where approved, when approved-with Remarks
			2014; Columbia(2003), 18000 hectares grown in 2014; India(2002), 1,16,00,000 hectares grown in 2014; Mexico(1996), 160,000 hectares grown in 2014; Myanmar(2006), 318,000 hectares grown in 2014; Pakistan(2010), 2,850,000 hectares in 2014; Paraguay(2013), 36000 hectares in 2014; South Africa(2000) 9000 hectares in 2014; Sudan(2012), 9000 hectares in 2014; USA(1995), 45,00,000 hectares in 2014
	Egg Plant (Brinjal)	Insect resistance	Bangladesh (2013), 12 hectares in 2014
	Eucalyptus	Altered growth	Brazil (2015), has not yet been cultivated commercially.
	Flax	Herbicide tolerance varieties	USA (1999), has not yet been cultivated commercially; Canada (1996), approval rescinded in 2001.
	Grass	Herbicide tolerance varieties	USA (2003), has not yet been cultivated commercially
	Maize	Improved insect protection and herbicide tolerance for efficient weed management	Argentina(1998), 30,00,000 hectares grown in 2014; Brazil(2007), 12,500,000 hectares grown in 2014; Canada(1996), 14,00,000 hectares grown in 2014; Columbia(2007), 81,000 hectares grown in 2014; Cuba(2001), 3000 hectares grown in 2014; European Union(1998)-being grown in Portugal(8542 hectares grown in 2014), Spain(131,538 hectares grown in 2014), Czech Republic(1754 hectares grown in 2014) and Romania(771 hectares grown in 2014); Honduras(2001), 29,000 hectares grown in 2014; Paraguay(2012), 500,000 hectares grown in 2014 ; Philippines(2002), 831,000 hectares grown in 2014; South Africa(2002), 2,150,000 hectares grown in 2014; Uruguay(2003) 90,000 hectares grown in 2014; USA(1995), 34,500,000 hectares grown in 2014
	Papaya	Virus resistance	China (2006), 8475 hectares griwn in 2014; USA (1996), 1000 hectares grown in 2014

S. No.	GE Plants	Traits/Uses	Countries where approved, when approved-with Remarks
	Petunia	Modified flower color	China (1998), grown in small acreage
	Plum	Viral resistance varieties	USA (2007), has not yet been cultivated commercially
	Poplar	Insect resistance	China (1998), 543 hectares cultivated in 2014.
	Potato	Improved quality, anti-bruising and viral resistance	USA (1997), viral resistance varieties, (2015) for improved quality traits; Canada (1999) viral resistance varieties. Neither in USA nor in Canada yet cultivated
	Rice	Insect resistant varieties	Iran (2004), grown up to 2005, then discontinued
	Rose	Ornamental modified flower color	Australia (2009), renewal for commercial cultivation surrendered; Columbia (2010), only green house cultivation for exports; Japan (2008), USA (2011). Cultivated in small area
	Soybean	Improved insect protection and herbicide tolerance for efficient weed management	Argentina (1996), 20,800,000 hectares cultivated in 2014; Bolivia (2005), 10,00,000 hectares cultivated in 2014; Brazil (1998), 29,100,000 hectares cultivated in 2014; Canada(1995) 2,200,000 hectares cultivated in 2014; Chile(2007) 1000 hectares cultivated in 2014; Costa Rica (2001) 1.7 hectares cultivated in 2014; Mexico(1996), 10,000 hectares cultivated in 2014 ; Paraguay(2004), 33,00,000 hectares cultivated in 2014; South Africa(2001), 552,000 hectares cultivated in 2014 ; USA(1993), 3,23,00,000 hectares cultivated in 2014; Uruguay(1996), 1,550,000 hectares cultivated in 2014
	Squash	Resistance against watermelon mosaic virus and zucchini yellow mosaic virus	USA (1994), 1000 hectares cultivated in 2014
	Sugar beet	Herbicide tolerance	Canada (2001), 15000 hectares in 2014; USA (1998), first commercialized in 2007, production blocked in 2010 and resumed in 2011, 479,000 hectares cultivated in 2014

S. No.	GE Plants	Traits/Uses	Countries where approved, when approved-with Remarks
	Sugarcane	Insect resistance and Drought tolerance varieties	Brazil (2017), commercial cultivation authorization provided for insect resistance, not yet commercial cultivated; Indonesia (2013), drought tolerance varieties, only environmental clearance provided, not yet approved for commercial cultivation
	Sweet Pepper	Virus Resistance varieties	China (1998), cultivated in small lands
	Tobacco	Herbicide resistant varieties	China (1992), not grown commercially since 1995 due to strong opposition from tobacco importers
	Tomato	Delayed Ripening, Virus resistance	China (1999), virus resistant variety cultivated in small area; USA (1992), delayed ripening variety, commercial production stopped in 1997

In addition to the above, several crops are at various stages of research and field trials. It is anticipated that in due course many newer as well as existing GM crops shall get introduced in commercial agriculture in different countries.

2.2.2 Indian Status

In India, lepidopteran insect-resistant Bt cotton is the only GM crop approved for commercial cultivation.

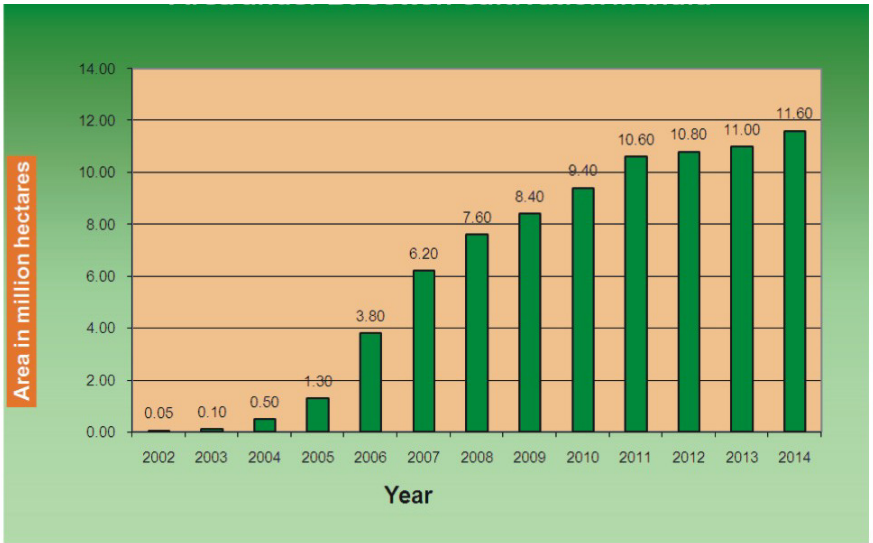
What is Bt Cotton?

The genetically materials or genes coding for Bt toxin are inserted into cotton genome thereby producing Bt Cotton. Bt stands for *Bacillus thuringiensis*. This bacillus produces over 200 different toxins which are harmful to different insects. These toxins are proteins coded by specific Cry genes of the bacillus. A few selected Cry genes are used for producing genetically modified cotton seeds. All genetically modified cotton seeds are individually or collectively named as Bt Cotton.

Since its introduction in 2002, the total area under Bt cotton has increased from 0.05 million hectares to 11.6 million hectares in 2014 (Figure 2.1[18]).

[18] Document on Frequently Asked Questions about Genetically Engineered (GE) Plants – Phase II Capacity Building Project on

Figure 2.1: Area under Bt cotton cultivation in India



As of now, Bt cotton is cultivated in more than 90% of the area under cotton cultivation. The introduction of Bt cotton has resulted in India becoming the largest producer of cotton in the world.

In India, several public and private sector institutions are involved in the research and development of GE plants. More than 20 plants with varying traits such as insect resistance, herbicide tolerance, abiotic stress tolerance, viral resistance, fungal resistanceetc. in varieties and hybrids are under various stages of field trials (Table 2.2)

Table 2.2:An indicative list of GE plants under research and development/ field trials in India[19]

S. No.	Plant	Trait
1.	Banana	Antimicrobial peptide (AMP) gene
2.	Brinjal	Insect resistance
3.	Cabbage	Insect resistance
4.	Castor	Insect resistance
5.	Cauliflower	Insect resistance
6.	Chickpea	Abiotic stress tolerance, insect resistance

Biosafety published by Ministry of Environment, Forest and Climate Change in association with Biotech Consortium India Limited, 2015, Page 13

[19] Document on Frequently Asked Questions about Genetically Engineered (GE) Plants – Phase II Capacity Building Project on Biosafety published by Ministry of Environment, Forest and Climate Change in association with Biotech Consortium India Limited, 2015, Page 15

S. No.	Plant	Trait
7.	Corn	Insect resistance, herbicide tolerance
8.	Cotton	Insect resistance, herbicide tolerance
9.	Groundnut	Virus resistance, abiotic stress tolerance
10.	Mustard	Hybrid seed production
11.	Okra	Insect resistance
12.	Papaya	Virus resistance
13.	Pigeonpea	Insect resistance
14.	Potato	Tuber sweetening, fungal resistance
15.	Rice	Insect resistance, diseases resistance, hybrid seed production, nutritional enhancement
16.	Rubber	Abiotic stress tolerance
17.	Sorghum	Insect resistance, abiotic stress tolerance
18.	Sugarcane	Insect resistance
19.	Tomato	Insect resistance, virus resistance, fruit ripening
20.	Watermelon	Virus resistance
21.	Wheat	Effect of mutant strains Azotobacter

As per recent survey[20] by MoEFCC, India has a very rich and innovative R&D pipeline. More than 85 different plant species are being used for experimental work in research projects. These include plants for food, livestock feed, fiber, fuel and dietary or medicinal purposes.

2.3 NEED FOR IP IN THE CONTEXT OF LMOS IN AGRICULTURE

During the recent time, several crisis related to food safety surfaced globally as the outbreak of Mad Cow disease[21], diesel oil contamination in palm oil[22], *Salmonella* and *E.coli* in poultry products[23] and many other similar instances have taken place.These events have brought down public confidence on the safety of agricultural products and foods made there from including processed food. Traceability of contaminants in such products became very relevant[24] and led to the

[20] Document on Genetically Engineered Plants in the Product Development Pipeline in India: Results from a survey conducted under the auspices of the Phase II Capacity Building of Project – Phase II Capacity Building Project on Biosafety published by Ministry of Environment, Forest and Climate Change

[21] The spread of mad cow disease, CNN, http://edition.cnn.com/2003/HEALTH/12/23/madcow.chronology.reut/

[22] Fizura CH et. al, Effect of diesel contamination on capacitance values of crude palm oil, Journal of Engineering Science and Technology Vol. 9, No. 3 (2014) 286 - 292, http://jestec.taylors.edu.my/Vol%209%20Issue%203%20June%2014/Volume%20(9)%20Issue%20(3)%20286-292.pdf

[23] Adeyanju GT et. al , Salmonella and Escherichia coli contamination of poultry meat from a processing plant and retail markets in Ibadan, Oyo State, Nigeria, SpringerPlus 2014, 3:139, http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4320193/pdf/40064_2013_Article_1466.pdf

[24] Moe T, Perspectives on traceability in food manufacture, Trends in Food Science & Technology 9 (1998), 211-214, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.408.8719&rep=rep1&type=pdf

need for IP in agriculture.The introduction of GM crops also led to food safety concerns amongst general public and demand from consumers to have “the right to choose”, despite approval from regulatory authorities.

GM crops are subjected to food safety assessment prior to their approval introduction. Decision of a country isbased on scientific and rational evaluation of safety of such products and the regime of regulations in place for IP. Commercial release of all crops including GM crops is always done subject to certain conditions so as to enable the regulators to review the authorization order for release at a later date at any point in time. The regulators reserve the powers to enable the monitoring of the environment as well as the issues of food and feed safety, being constantly monitored in order to continuously assess, especially the safety of GM crops.

Even though such safeguards are built-in within the purview of all the regulators, the issues of safety are not yet fully resolved in the minds of certain section of society. Consequently, implementation of IP policies to ensure that such agricultural commodities are kept segregated has assumed added significance.

A large number of countries including the United States, Canada, Argentina, Brazil, Australia, China, and India have allowed the commercial cultivation of crops, using seeds developed through r-DNA technology. Many other countries including European Union still have conservative views on the authorization of such crops for cultivation; however, these countries have authorized imports of GM foods within their territory.

There is no global treaty on seeking approval for a country's authorization of its GM events locally and concomitantly obtaining approvalin a foreign country. Even global cooperation and multilateral information sharing mechanism for fructifying such events do not exist. As a result, asynchronous approvals have taken place at several parts of the world and this has also affected transboundary movement and global trade of GM crop [25, 26].Such asynchronous approvals have led to additional requirements for segregation and traceability during transboundary movement of GM crops. Simultaneously, several countries are instituting labeling laws that require

[25] Huang J et. al, Trade and Economic Implications of Low Level Presence and Asynchronous Authorizations of Agricultural Biotechnology Varieties: A Case Study in China, 2012, http://ageconsearch.umn.edu/bitstream/125215/2/Trade%20and%20Economic%20Implications%20of%20Low%20Level%20Presence%20and%20Asynchronous%20Authorizations%20of%20Agricultural%20Biotechnology%20Varieties.pdf

[26] Kalaitzandonakes N et. al, The Impact of Asynchronous Approvals for Biotech Crops on Agricultural Sustainability, Trade, and Innovation, CAST, 2016, http://www.cast-science.org/download.cfm?PublicationID=284473&File=10307daf83cfdff596df53146e3f6b391d6aTR

segregation and identification of seeds and food products developed through r-DNA technology.

All these diverse ways and impressions of the society for handling GM crops have led to the growth of additional criteria for identity preservation of GM crops and foods derived thereof. Concurrently the demand for programs that can certify the identity and composition of such agricultural commodities has also arisen and continues to emerge in future time. In many situations, changes in cultivation, harvesting, production and marketing procedures for such agricultural commodities are required to meet more stringent standards of identity preservation.

2.4 LABELING REQUIREMENTS FOR LMOs IN INDIAN CONTEXT

Labeling of GM foods was first considered by the Ministry of Health and Family Welfare, wherein draft rules were issued under the "Prevention of Food Adulteration Act" for introduction of mandatory labeling requirements in March, 2006. The draft rule 37-E, Labeling of Genetically Modified food, stipulates[27] that all primary or processed foods or food ingredients or food additives derived from a GM food would have to be labeled; in case of imports, the GM foods would have to indicate the status of approval in the country of origin.

Subsequently, Food Safety and Standards Act, 2006 (FSSA, 2006) was promulgated[28] in August 2006. FSSA, 2006 elaborates the legal position of handling GM food wherein **Section 22**includes provisions for dealing with genetically modified food. Section 22 para 2 elaborates as under:

"genetically engineered or modified food" means food and food ingredients composed of or containing genetically modified or engineered organisms obtained through modern biotechnology, or food and food ingredients produced from but not containing genetically modified or engineered organisms obtained through modern biotechnology.

Section 23 describes the packaging and labeling requirement of such foods, implying that such foods needs to be identity preserved and labeled.However, the

[27] PREVENTION OF FOOD ADULTERATION (......... AMENDMENT) RULES, 2006, MINISTRY OF HEALTH AND FAMILY WELFARE, (Department of Health), NOTIFICATION, New Delhi, the 10th March, 20066, http://www.pfndai.com/Gazette%20pdfs/054_152_2006.pdf

[28] Food Safety and Standards Act 2006, http://lawmin.nic.in/ld/P-ACT/2006/The%20Food%20Safety%20and%20Standards%20Act,%202006.pdf

procedures for handling GM food have not been elaborated nor there are any guidelines for dealing with these.

Later, the Indian Department of Consumer Affairs passed a regulation in May 2012 which was enforceable with effect from 1st January 2013 and which required labeling of packaged food. This regulation required for packaged GM food to label as "Every package containing the genetically modified food shall bear at the top of its principal display panel the word 'GM' "[29]. The details of the implementation process of this regulation have not yet been provided by the Government.

Several questions such as the need to specify the maximum threshold level of a GM trait in packaged food, the applicability of the scope of regulation for products derived from recombinant DNA technology but not containing any detectable levels of GM trait such as refined soybean oil (derived from GM Soybean), refined canola oil (extracted from GM Canola), refined sugar (derived from GM Beet) etc. have not been spelt out. Such products essentially of GM origin such as soybean oil and rapeseed oil imported from western countries like USA, Canada and other western countries, are being imported into the country and require labeling (being of GM origin) consistent with the promulgated law . These products are not being labeled yet as GM products in the packaged containers that are available for purchase from the retail market. It appears that imposing labeling requirements on the traded containers may impact international trade especially imports by Indian traders.

In Indian context therefore, if labeling policy requires that even products not containing detectable GM ingredients are also to be labeled because of their GM origin, a reliable identity preservation system for such agricultural products from seed production to cultivation followed by manufacture of the final product is to be in place which seems to be a proposition very difficult to implement as several actors are involved. Since in Indian market most of the food is sold in the form of non-packaged commodity through small, medium and large fixed shops as well as street hawkers, it would be an impossible task to deal with these actors and to implement labeling policies. It is not therefore clear if the law would be enforceable to transactions from such unpackaged products sold through such vendors. It appears that the focus of the notification is on packaged food sold through organized marketing channels; even in such cases several procedural requirements are to be in place, which seem to be lacking in the present notifications and directives of the Government.

[29] 2012 Notification,http://164.100.158.12/consumer/sites/default/files/userfiles/1st%20amendment%20of%202012%20in%20PCR.pdf

Another one issue, which is apparent, is that trade of products utilizing Bt Cotton technology, which was approved in the country for commercial cultivation of Bt Cotton in 2002. After production of the lint, the Bt Cotton seeds are used for extracting oil which are edible and are being widely traded. Bt Cotton seed mill after oil extraction as also ground Bt Cotton seeds are used as cattle feed in consumer-packaged forms.The existing rules of labeling havenot however been applied on the use of Bt Cotton based products such as Bt Cotton oil and Bt Cotton seed meal (used in animal feed). Bt Cotton seeds are however truthfully labeled in India in accordance with the Indian Seeds Act, Rules and Procedures for easing the cultivators to purchase authentic seeds. Details regarding the relevant rules and procedures can be seen elsewhere[30].

2.5 DISCUSSION

The scope of the study is to assess the feasibility of implementation of IP for LMOs in India followed by recommendations for implementation of such as system appropriate to Indian conditions. The study is timely considering the fact that research and development in LMOs is active in the country.

While a large number of countries have allowed the commercial cultivation of LMOs in their territories, many other countries especially European Union has reservations in doing so. Simultaneously many countries have instituted labeling laws that may require segregation and identification of seeds and food products developed through modern biotechnology. Indian government has also introduced mandatory labeling rules for GM packaged food and hence it is extremely important to study the feasibility of an IP system for LMOs in India.

[30] Legislations for Seed Quality Regulation In India, http://www.cicr.org.in/pdf/legislation_seed_quality.pdf

CHAPTER 3
CARTAGENA PROTOCOL ON BIOSAFETY AND ARTICLE 18

3.1 SALIENT FEATURES OF THE CARTAGENA PROTOCOL ON BIOSAFETY

The Cartagena Protocol on Biosafety (CPB) is the first International Protocol[3]that addresses the issues on **transboundary movement** of “living modified organisms” (LMOs). The issues of biosafety emanating from use of modern biotechnology were identified initially by the Convention on Biological Diversity (CBD)[4]that was finalized in Nairobi in May 1992; CBD became operational from 29 December 1993. CBD in its Article 8(g) and Article 19 (Para3) sought to make certain the development and enumeration of procedures to ensure safety from the use of biotechnology to the environment taking also into account its concerns to human health. In this way through provisions of the CBD the issues of biosafety emanating from the use of LMOs became the legally binding instrument to all nations that were and are “Parties” to it. The term “LMO” was coined instead of “GMO” in Article 8 Para (g) of the document on CBD to distinguish and highlight the need for assessment of safety of “living” organisms instead of “dead” organisms basically to differentiate between LMOs that propagate and “products thereof” such as processed food products thereof are exempted from the provisions of CPB.

All aspects of use of LMOs including development, propagation, cultivation, harvesting, handling, transport, packaging, use and identification within a territory is governed by the laws, rules and procedures of the country using and utilizing LMOs. The objective of CPB is to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health. The CPB focuses on transboundary movement of LMOs in particular.

The rules and procedures set out in the CPB vary in accordance with the intended use of LMOs and accordingly the Protocol recognizes three categories of LMOs viz. LMOs for contained use; LMOs for Food Feed and Processing (FFP) and LMOs for Intentional Release.

In addition to the documentation requirements for transboundary movement, the rules and procedures for decision making (Article 10)requireParties to provide information on the identity of LMOs as elaborated in Annex 1 Para (i) of the Protocol. The Article 10 also provides that the decision of the Party of import must be based on a risk assessment in accordance with the provisions of Article 15 and Annex III (Para 5) to the Protocol. For the purpose of risk assessment, information on the identity of the LMO is of paramount importance which has been recognized and set out under the provisions of Article 18. These elaborations were based on the premises and surmise that *novel genetic manmade replicable combinations* could also pose risks to human health. In this process therefore Identity Preservation (IP) aspects of LMOs became relevant and focused.

The rules and procedures set out in the CPB vary in accordance with the intended use of LMOs and accordingly the Protocol recognizes three categories of LMOs viz: LMOs for contained use; LMOs for Food Feed and Processing (LMOs-FFP) and LMOs for Intentional Release. These distinctions were part of the compromise agreed upon by countries in order to bring LMOs-FFP within the scope of the Protocol.

3.2 ARTICLE 18 - SCOPE AND OBJECTIVE

Article 18 of the CPB deals elaborates the requirements relating to the handling, transport, packaging and identification of LMOs. Article 18 has three paras and the text is reproduced below:

"Article 18: Handling, Transport, Packaging and Identification

2. Each Party shall take measures to require that documentation accompanying:

(a) Living modified organisms that are intended for direct use as food or feed, or for processing, clearly identifies that they "may contain" living modified organisms and are not intended for intentional introduction into the environment, as well as a contact point for further information. The Conference of the Parties serving as the meeting of the Parties to this Protocol shall take a decision on the detailed requirements for this purpose, including specification of their identity and any unique identification, no later than two years after the date of entry into force of this Protocol;

(b) Living modified organisms that are destined for contained use clearly identifies them as living modified organisms; and specifies any requirements for the safe handling, storage, transport and use, the contact point for further information, including the name and address of the individual and institution to whom the living modified organisms are consigned; and

(c) Living modified organisms that are intended for intentional introduction into the environment of the Party of import and any other living modified organisms within the scope of the Protocol, clearly identifies them as living modified organisms; specifies the identity and relevant traits and/or characteristics, any requirements for the safe handling, storage, transport and use, the contact point for further information and, as appropriate, the name and address of the importer and exporter; and contains a declaration that the movement is in conformity with the requirements of this Protocol applicable to the exporter."

Clearly the above paragraphs set out the responsibility of each party quantified through documentation to identify LMOs in the "accompanying papers" in situations where LMOs are being handled, packaged and transported for transboundary movement to and across countries. Three kinds of documents for handling the three situations of transboundary movement of LMOs in the above paragraphs include LMO for direct use as food, feed and processing (LMOs-FFP), LMOs for contained use within the territories of parties importing those (LMO for Contained Use) and LMOs meant for intentional introduction into the environment of parties importing them (LMOs-Intentional Introduction into Environment).

Even though the intention through the Article 18 of the CPB was apparently clear for parties requiring preparation of "accompanying documents", there were contentious issues which were not above board and therefore each paragraph of the above article was discussed threadbare in the subsequent meetings of parties including various Conference of the Parties serving as the meeting of the Parties (COP-MOP) meetings to arrive at an agreed decision about "accompanying documentation" for transboundary movement of LMOs. While consensus on the documentation and identification requirement for transboundary movement of LMOs has been achieved, unanimity on the documentation requirement and phasing out the "may contain" language for LMOs- FFP under Article 18 (2a) is yet to be reached."

3.3 DOCUMENTATION REQUIREMENTS FOR LMOs-FFP

As evident from above, the issue of identity preservation is related to LMOs-FFP.

Article 18 para (2) (a) specifically the issue of "may contain" language was one of the most controversial issues in the final stages of the negotiations of the Protocol. Some countries in the negotiations were concerned that imposing clear identification requirements for transboundary movements of LMOs-FFP would indirectly impose costly segregation or identity preservation obligations, for example requiring genetically modified and non-genetically modified crops and grains to be segregated at all stages of the production process and during shipment, and measures to be taken to avoid any accidental trace contamination by LMOs. Several of the major grain exporting countries were also of the view that once " substantial equivalence" has been established there is no further safety issue and therefore would like to continue with the ' may contain " language.

In the first meeting of the COP-MOP (COP-MOP I) held during February 23-27, 2004 at Kuala Lumpur the issues of Article 18 of CBD were discussed in details. The discussions took into consideration the recommendations of the Intergovernmental Committee for the Cartagena Protocol (ICCP) pertaining to the subject matter of Article 18. The issues under Paragraph 2(a), was referred to an Open-Ended Technical Expert Group on identification requirements of living modified organisms that are intended for direct use as food or feed, or for processing on the basis of the terms of reference specified as brought out in the following seven points:

i) The kind of documentation that should accompany LMOs.
ii) The type and extent of information that is necessary to clearly identify LMOs be set to used as food, feed or for processing.
iii) The implications of the language "may contain" to identify LMOs set to used as food, feed or for processing.
iv) The necessity for unique identification
v) Adventitious and/or unintentional presence of LMOs in non-LMO shipments or unauthorized LMOs in authorized LMO shipments and therefore the question of threshold.
vi) The need for a system for identity preservation and the associated costs.
vii) Methodologies for sampling, detection and identification of LMOs intended for use as food, feed or processing.

The report of the Open Ended Technical Group in the context of Article 2(a) was considered in the third meeting of COP-MOP at Curitiba Brazil wherein a compromise agreement was reached on the detailed documentation requirements for shipments of living modified organisms that are intended for direct use as food or feed, or for processing (paragraph 2 (a) of Article 18. The compromise package, which is contained now in decision BS-III/10 Para 4 requests Parties and urges other Governments to take measures to ensure that documentation accompanying living modified organisms intended for direct use as food or feed, or for processing is in compliance with the requirements of the country of import and clearly state the information specified in paragraph 4 of the decision. According to this decision, in cases where the identity of the living modified organism is known through means such as identity preservation systems, the documentation is required to state that the shipment contains living modified organisms, and in cases where the identity of the living modified organisms is not known through means such as identity preservation systems, it has to state that the shipment may contain one or more living modified organisms that are intended for direct use as food, or feed, or for processing. *Decision BSIII 6 Para 4 further acknowledges* that the expression "may contain" does not require a listing of living modified organisms of species other than those that constitute the shipment;

It was further decided (Decision BS III10 (7)) to review and assess, at its fifth meeting, experience gained with the implementation of paragraph 4 above, with a view to considering a decision, at its sixth meeting, regarding the phasing out of the " may contain" language.

The matter was reviewed by COP-MOP in the fifth meeting held in October 2010 at Nagoya, Japan. Taking into account the limited experience gained to date in the implementation of paragraph 4 of decision BS-III/10[31], it was decided (Decision BS V/8 Para 6) to postpone the decision-taking referred to in paragraph 7 of decision BS-III/10 until its seventh meeting. This decision further requested Parties, other Governments and relevant organizations to submit to the Executive Secretary, no later than six months prior to the seventh meeting of the Parties to the Protocol, further information on experience gained with the implementation of paragraph 4 of decision BS-III/10, including any information on obstacles that are encountered in the implementation of these decisions as well as specific capacity-building needs to implement these decisions.

[31] Decision BS-III/10, http://www.cbd.int/decisions/?m=MOP-03&n=10

The clarifications obtained thus far up to the **seventh** meeting[32] of the COP-MOP on Article 18 of the CPB Protocol were to be guided[33] by decision BS-VII/8 and are summarized below:

On **types of documentation to accompany LMOs and types and extent of information of accompanying document**, COP-MOP 7 in its meeting held on 29 Sept-3 Oct 2014 at Pyeongchang, Republic of Korea requested Parties to continue taking measures as embodied[7] in MOP 3 Decision BS-III/10 and the accompanying documentation requirement. In summary, such documentation should have been in compliance with the domestic regulatory framework and should also be in accordance with the regulatory framework of the country of import and should clearly clarify about anyone one or more of the following possibilities:

(a) In cases where the identity of the living modified organisms *is known* through means such as identity preservation systems, that the shipment contains living modified organisms that are intended for direct use as food or feed, or for processing;
(b) In cases where the identity of the living modified organisms *is not known* through means such as identity preservation systems, that the shipment may contain one or more living modified organisms that are intended for direct use as food or feed, or for processing;
(c) That the living modified organisms *are not intended* for intentional introduction into the environment;
(d) The common, scientific and, where available, commercial *names* of the living modified organisms;
(e) The *transformation event code* of the living modified organisms or, where available, as a key to accessing information in the Biosafety Clearing-House, its *unique identifier code*;
(f) The *Internet address* of the Biosafety Clearing-House for further information

It was further clarified by COP-MOP 7 that documentation for trans-boundary movement of LMOs between Parties and Non-Parties should be consistent with the objectives of the Protocol. The documentation requirements for transboundary movement of LMOs for three different type of uses are summarized in **Table 3.1**. The

[32] COP-MOP 7, https://www.cbd.int/doc/meetings/bs/mop-07/official/mop-07-16-en.pdf
[33] BS-VII/8: Handling, transport, packaging and identification (Art 18), https://www.cbd.int/doc/meetings/bs/mop-07/official/mop-07-16-en.pdf

system of Unique Identifiers developed by OECD and adopted under CPB is given in **Box 3.1**.

Table 3.1 Documentation Requirement for Transboundary Movement of LMOs

LMOs-FFP **Article 18 (2a)**	**LMOs for contained use** **Article 18 (2b)**	**LMOs for intentional introduction into environment** **Article 18 (2c)**
• Where identity of theLMOs is known, that theshipment contains LMOs-FFP • Where identity of the LMOs is not known, thatthe shipment "may contain"one or more LMOs-FFP • That the LMOs are not intended for intentional introduction into the environment • Common, scientific&, where available, commercial names of the LMOs • Transformation event code or, where available, the LMOs' unique identifier • The website of the Biosafety Clearing-House (BCH) for further information	• Clearly identifies content as LMOs including common & scientific names of organisms and as "destined for contained use" • Provides the name & address of the consignee, and exporter or importer, including contact details necessary to reach them as fast as possible in case of emergency • Specifies any requirements for the safe handling, storage, transport and use of the LMOs. In the event that there is no requirement, indicate that there is no specific requirement • Provides further information, where appropriate, such as the commercial name of the LMOs, new or modified traits, transformation events, risk class, specification of use, and any unique identification as a key to accessing information in the BCH	• Clearly identifies content as LMOs and briefly describes the organisms, including: ▪ Common & scientific names ▪ Relevant traits and genetic modification, including transgenic traits and characteristics such as transformation event(s) or reference to system of unique identification • Gives any requirements for safe handling, storage, transport and use. In the event that there is no requirement, indicates that there is no specific requirement • Contains the name & address of exporter & importer • Provides a contact point for further information, including an individual or organization in possession of relevant information in case of emergency • Includes a declaration that movement of the LMOs is in conformity with the Protocol's requirements • Provides further information, where appropriate, e.g. commercial name, risk class & import approval for first transboundary movement of the LMO

Box 3.1 Unique identifiers

- Documentation requirements for all categories of LMOs require reference to a unique identifier code
- To date, only one unique identification system exists: OECD Unique Identifiers for Transgenic Plants
- OECD Unique Identifier is a simple alphanumeric code that is given to each living modified plant that is approved for commercial use
- Developers of transgenic plants are the ones to assign the unique identifier
- 9-digit code composed of 3 elements separated by dashes
    - 2 or 3 alphanumeric digits to designate the applicant;
    - 5 or 6 alphanumeric digits to designate the transformation event; and
    - 1 numerical digit for verification

Example: MON-00810-6 Monsanto's YieldGard Maize

- Unique identifier codes can be used to search BCH for information about specific LMOs

3.4 IDENTITY PRESERVATION IN THE CONTEXT OF CPB

The Parties took note of the fact that throughout the entire production and distribution chains, identity preservation was a complex task. Identity Preservation refers to procedures that must be maintained to track and quantify the identity of the target product. Unique identification as well as adventitious presence of LMOs in non-LMO consignment is therefore relevant for tracking the presence of LMOs in consignments meant for transboundary movement. At the time of initial discussions on this point the regulations of European Union define the objectives of traceability at all stages of the placing of LMO products in the market. The industry argued that such a procedure would cause substantial increase in costs. It was calculated that grain handling in Unites States with the implementation of identity preservation would cost an increased amount of 6-8% of the cost of production, which was considered substantial[34].An Australian report also indicated that implementing a procedure of Identity Preservation would imply substantial increase in the cost of bulk handling of commodities[35].

3.5 OTHER RELEVANT ISSUES DISCUSSED UNDER CPB

Adventitious and/or unintentional presence of LMOs in non-LMO shipments and the question of threshold: it was generally understood and acknowledged that shipments of LMOs meant for use as food, feed or for processing may not be completely pure. Adventitious presence of LMOs in non-LMO shipments cannot often

[34] BuckwellA et. al, Economics of Identity Preservation for Genetically Modified Crops, http://ceasc.com/Images/Content/Final%20FBCI%20report%201745.pdf
[35] GM crops and the marketplace, http://www.abca.com.au/wp-content/uploads/2012/09/ABCA_InfoPaper_9_v2.pdf

be guaranteed due to phenomenon of adventitious or unintended presence of LMOs in such consignments. Mixing can happen due to transfer of LMO pollens to non-LMO crops by natural process. Article 25 of CPB stipulates that the party of import on analyzing a shipment received from party of export and finding the presence of LMOs can consider the shipment illegal based on domestic laws of party of import. To tackle such situations, different actors make different suggestions. The International Grain Trade Coalition (IGTC) proposed that 95% purity of a consignment or more should be considered as a legal shipment. The European Union (EU) on the other hand adopted a threshold of 0.9% for the adventitious presence of approved LMOs in food and feed. Switzerland on the other hand allowed a threshold of 1% of LMOs in non-LMO food products. Article 17 of CPB stipulates that third parties affected from the release of LMOs are to be notified by both the party of export as well as the party of import on such occurrences and to take steps/measures to mitigate the adverse effects of LMOs to environment and to human health at the sites of release which may be an “occurrence” causing the unintentional release of LMOs. All these issues are indeed complex and there was no unanimity on one accepted view to tackle the situation. Therefore, for the transboundary movement of LMOs in trade, the documentation papers mentioning “may contain” language was accepted along with other relevant documents for effecting international trade.

Sampling and detection: based on the discussion in various meetings revealed that there was a need to determine the presence of LMOs in non-LMO consignment and that there would have to be appropriate sampling and testing procedures from bulk grains that are transshipped to different destinations. During the time of discussion, there was no standard sampling or testing methodologies for LMOs. Different sampling procedures would result in different results and would not guarantee a comparable result. Therefore, there was a need to develop standard sampling and testing methodologies. The grain trade industry suggested that such testing protocols should be developed by international bodies.

Because of divergence of issues to be dealt with there has not yet been any unanimous conclusion on this issue though it was surmised that this issue could be handled scientifically. However, eventually for effecting existing international trade, the language “may contain” along with the relevant environmental and food safety documents/ certificates are being used for effecting international trade.

3.6 DISCUSSION AND REMARKS

Cartagena Protocol on Biosafety was specifically negotiated under CBD with a view to ensure safe transfer, handing and use of LMOs derived from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity including risks to human health. LMOs were invented and utilized in agriculture for imparting technological and economic benefits to societies in different countries. LMOs are developed to associate together one or more useful genes from a diverse variety of living sources to impart specific characteristics in the developed plants such as pest resistance, herbicide tolerance, microbial disease resistance, enhanced storage life of the agricultural produce and altered nutritional profile to impart technological benefits to agriculture. Worldwide, farmers need new and productive seeds along with management practices to increase their farm productivity and in these directions LMOs play an important role. As the LMO technology is relatively new and young, and as the science of this new technology is yet evolving, there are perceived risks among people from using LMOs in agriculture and the perceptions vary from country to country and even for region to region.

The recommendations of the CPB from time and time have been the guiding principles for taking the Identity Preservation issues of LMOs to the world community. This issue has become important for certain countries in the context of Decision BS III 10. However, in spite of efforts by Parties and non-Parties to bring in unanimity regarding documentation on the identification of LMOs-FFP and phasing out the "may contain" language, there has been only minimal progress as seen from the submissions made by Countries and summarized in the Note of the Executive Secretary prepared in pursuance of Para 4 of Decision BS-III/10 as well as implementation of Decision BS-V/8 of the CBD[36]. The main reason for this could be:

1. Limited experience in the use of LMOs, lack of adequate human and institutional capacity and in adequate resources to address issues related to safety of LMOs in general and in particular deployment of IP systems in agriculture.
2. Diverse views on the perception of LMO safety.
3. Trade related barriers under WTO.

[36] UNEP/CBD/BS/COP-MOP/7/8, https://www.cbd.int/doc/meetings/bs/mop-07/official/mop-07-08-en.pdf

CHAPTER 4
STATUS OF IDENTITY PRESERVATION (IP) FOR AGRICULTURE COMMODITIES AND GM CROPS

4.1 INDIAN SCENARIO

4.1.1 Agriculture commodities

Indian economy is vastly dependent upon agriculture as this sector provides employment to more than 65% of its workforce. Productivity in Indian agriculture has substantially improved over the years especially after Green Revolution in 1970s, but yet the Indian farmers have remained poor. This is mainly because the poor farmers have not been able to realize stable remunerative prices for their crop produce. Indian system of substantial sell of agricultural produce is through government-mandated market place sale in 'Mandis' where traders are able to exploit the farmers as transactions are effected through auctioning. Poor farmers have inadequate opportunity to value the prices of their produce as they are not familiar with day to day information of the market prices. As a result even quality goods have most often fetched lower prices. With the existing practices of procuring grains from the Indian "Mandis" it does not seem to be possible to enforce a system of segregation of different kinds of grains as there is yet no system in place, the labour force is largely illiterate without training to carry our segregation and that the Warehousing Corporation that is used for the final storing of procured grains have inadequate capacity to store and maintain segregation[37] .

In order to improve upon the prevailing practices, several initiatives were taken by large Indian multinational companies one of which is worth mentioning which is e-Choupal introduced by ITC Agro-Tech Ltd (ITC)[38],[39] ; in brief the model is to create awareness among a group of farmers through internet where several surrounding villages over an wider area are able to discuss and get acquainted to market trends of prices on a daily basis. In order to pay the farmers reasonable prices, the ITC has introduced a system of offering previous day's prices to farmers plus an amount for transportation of grains to the market place and in such practices the farmers are adequately being compensated with better price for their produce. In such a model,

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[37] Sahai S, Can GM and NON – GM Crops be segregated in India –Is coexistence possible? -2004, https://www.cbd.int/doc/external/cop-09/gc-coexist-en.pdf

[38] Sharma A,ITC E-Choupal: Empowering Rural India,2011- https://www.youthkiawaaz.com/2011/08/itc-e-choupal-empowering-rural-india-research/

[39] e-CHAUPAL, http://www.itcportal.com/businesses/agri-business/e-choupal.aspx

the farmers have been able to maintain their quality of grains by purchase of seeds, fertilizers and other inputs and maintaining records of their practices, obtained through ITC channel, thereby ensuring the buyer that the product is of certain quality traits. The IP system has been maintained in Indian agriculture for premium products/grains through such procedures profoundly. In another model, Pepsico India[40] has provided seed potato (planting material) to farmers with assurance of buying back the full production at previously agreed prices; this also ensures the farmers to receive returns which are more than their cost of production. Indian system of IP has also been maintained by other actors trading on rice where the buyers have teamed up with several villages incorporating within the system modalities for sowing of certified seeds, maintenance of the field conditions, harvesting of the produce and further processing up to the finished saleable grains. The system is also third party validated through audit so to ensure integrity and trust. All such endeavourshas been to ensure that quality products are traded. This situation has been in place for all agricultural crops, though in not-very-extensive scale and spread.

4.1.2 GM crops

In Indian context, Identity Preservation system for LMOs has not yet been physically established although LMOs are in use in commercial agriculture such as in the cultivation of genetically modified cotton known as Bt-cotton. As mentioned in Chapter2, Cotton seeds arising from the cultivation of Bt Cotton cultivars are utilized for extracting oil which are refined and used. The cotton cake containing Bt traits are utilized as feed and fodder; there is no identity preservation procedure in the use of such material. Imports of unrefined soybean oil are also taking place which may contain transgenic traits. In these cases, also there are no identity preservation procedures yet in place. All these materials have however been considered safe both environmentally as well as for use as food or feed or for other purposes.

Substances originating from genetically modified plants such as soybean oil and canola oil are also being imported from countries cultivating GM soybean and GM canola.

[40] Farmers' Friend-Pepsico India- http://www.pepsicoindia.co.in/purpose/environmental-sustainability/partnership-with-farmers.html

These products such as cotton seed oil, soybean oil and canola oil as also cotton seed based cake for cattle feed are available in Indian retail market .None are labeled as yet.

As has been mentioned in Chapter 2, India has already taken legislative steps to enact the labeling of packaged GM food from 2013. It will be known in future how the IP and labeling of such GM-origin /GM products are going to be tackled by the regulators of the country. Obviously, there will be need to elaborate detailed procedures for identifying what product requires labeling, what would be the threshold for declaring a product as GM or non-GM , the analytical procedures for detection and creation of competent laboratories for analysis. Concomitantly, procedures of SOP and documentation are to be evolved and legislated, which are measures requiring substantial investment and creation of infrastructure.

Besides Bt Cotton, several other GM crops are expected to be introduced in India during the coming future. Brisk research and developmental work is in progress on several crops as mentioned in Chapter 2 and elsewhere[41]. Information on field trial permissions provided by the GEAC of the Government of India for different kinds of transgenic plants with details of genes and events from 2007 to 2013 indicates that a large number of transgenic cultivars are being experimented upon in the country[42]. Many of these experiments are expected to culminate into open-field commercial cultivation of LMOs in India in years to come.

4.2 GLOBAL SCENARIO (AGRICULTURE CROPS AND LMOs)

Many other countries like India have also taken steps to label packaged GM foods. Presently, 64 countries around the world have legislative procedures requiring labeling of genetically modified foods[43].These countries include Australia, Austria ,Belgium, Brazil ,China, Denmark, Ethiopia, Finland, France, Germany ,Hungary, Indonesia, Italy, Japan, Malaysia, Netherlands New Zealand, Norway, Poland, Portugal, Romania, Russia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, United Kingdom, Vietnam among others. The USA and Canada have no laws yet requiring labeling of genetically modified foods although there are strong public opinion especially in USA, seeking for the labeling of GM food[44] Based on the public demand for labeling of GM food, the USA government had on July 7, 2016 has

[41] Ghosh PK et. al, Indian Rules, Regulations and Procedures for Handling Transgenic Plants, J. Sci& Indus. Res., Vol 59, Feb 2000, pp 114-120, http://nopr.niscair.res.in/bitstream/123456789/26568/1/JSIR%2059(2)%20114-120.pdf
[42] IGMORIS, http://igmoris.nic.in/multiLocReTrail.asp
[43] Labelling around the world- http://www.justlabelit.org/right-to-know-center/labeling-around-the-world/
[44] Right to Know-Just Label it - http://www.justlabelit.org/right-to-know-center/

legislated a procedure signed by the President requiring USDA to implement the rules around the legislation within a period of two years.[45]

In other countries however, the system of identity preservation for both Non-GM and GM crops, the IP procedures are more rugged. In **Canada**, the Canadian Identity Preserved Recognition System[46] (CIPRS) maintains a rugged value chain system for maintaining the identity preservation of a wide range of agricultural products. For example where exporting companies are required to deliver products such as soybeans defined attributes such as a certain variety, or a specific quality trait like high protein or high flavone content etc., the exporting companies engage contract farmers to grow such soybeans that would meet the exact specifications. The farmers procure IP certified seeds to ensure variety, purity and quality. Records are maintained by the farmers in a manner that the source of seeds could be traced back if required. At planting time, the equipments are meticulously clean to prevent any contamination. Throughout the growing season, frequent contact with farmers is made to ensure that standards are met. The fields are visited and conditions examined by experts several times to inspect for weeds and insects. The farmers receive a written report after each inspection to enable them to manage the field and the crops to atteain the best quality. Farmers keep full records of IP crops which include field maps, certified seed tags, invoices, fertilizers and chemicals used and deployed. During harvest, the farmers carefully clean the combines, augers, trucks, wagons and bins to prevent other seeds from mingling with the target crop. The harvested crop is stored in separate bins. Soybeans are harvested at 14% moisture stage. Harvest begins after soybean stems and weeds have dried down completely. At the elevator, the farm deliveries of the product is sampled and analysed for purity and quality check. Thereafter, these are binned according to quality and purity. At every stage third party testing and analysis is carried to ensure that best practices have been adopted. Grain companies document all such practices in the CIPRS management system. At the port, again strong vigilance is exercised and the vessels are cleaned meticulously before loading. The produce is then transported in containers that have been thoroughly inspected. In this process, as the shipment arrives at the destination, the buyer has full confidence that the purity and the quality have been maintained at every stage of production and handling. The increased cost

[45] Lugo D, U.S. Senate passes GM food labeling bill- http://www.sciencemag.org/news/2016/07/us-senate-passes-gm-food-labeling-bill
[46] Canadian Identity Preserved Recognition System- https://www.grainscanada.gc.ca/pva-vpa/ciprs-scrs-eng.htm

for establishing such a system can easily be absorbed within the prices that are received by the exporters as the buyer is ready to pay incremental increased prices. According to some estimates, an increaseof 2-3% of the cost of production of the IP is easily absorbable. After the introduction of GM canola, essentially the same system of IP is practiced by the country for trading this commodity. The four basic steps involved in the identity preservation system include discussion and agreement between the customer and the supplier on tests and documentation requirements to suit each actor's needs; ensuring that certified seeds where planted and documented at the farmers premises; taking steps to ensure eliminating the chances for other grains or contaminants to enter into the production system through inspection and documentation of maintenance of adequate stringent conditions to keep the handling equipment clean and to ensure adaptation of good practices for growing crops, harvesting them, transporting and storing the produce in storage basis; provide clear levels and documentation of processes adopted and testing results generated; and finally where required appointing independent third party auditors to ensure that the integrity of the system has been maintained to deliver the consignment to meet the appropriate standards.

Australia has implemented identity preservation with conventional crops such as malting barley and durum wheat and has obtained a better premium. The processes adopted are essentially similar to what Canada has adopted. IP ensures that the crop maintains its unique identity from the sown seed to the harvested material reaching the end users. The essential steps involve keeping the grain with desired traits separate from other grains right from seed planting stage to end use. After the introduction of GM crops, the perceptions of consumer's resistance to such products brought out new issues of unintended presence of GM material in premium non-GM products. Unintended presence of GM crops could emanate from cross pollination, re-growth in the field used earlier for raising GM crops as also co-mingling in the grain handling storage and marketing system. Therefore, practising identity preservation system is to significantly reduce the chances of co-mingling of GM crops with non-GM premium grains. Practising a systematic IP system would ensure maintenance of unique properties and qualities of premium grains thereby the supplier can assure the consumer of delivering quality product. Australia has successfully implemented identity preservation system in order to segregate GM products from non-GM products.[47] Establishment of such system has resulted in

[47] Foster M, GM grains in Australia-identity preservation-December 2006 - http://www.biosafetyscanner.org/pdf/doc/373_allegato.pdf

higher costs emanating from the need for certified planting seeds, enforcement of novel crop management techniques and cleaning requirements of the handling system after harvesting the grain in order to maintain proper quality. However, such additional costs have not been very high and have been calculated to be 4 - 6 % of the farm gate price in a typical year.

In **Europe,** Euro fins IP (Identity Preservation) Standard have been established[48] to preserve the supply of non-GM crops. The main requirements of the Euro fins IP Standard include implementation of two certification programme namely IP Control Programme involving complying of a set of requirements to be implemented in a single site wherever is its position within the supply chain; and IP Complete Programme which is a set of requirements available for a supply chain organized as a group covering the entire supply chain from seed to finished products. The certification is issued upon satisfactory completion of the certification audit. The audit requires generation of information on (a) A complete GMO risk assessment updated on a regular basis; (b) A relevant and effective traceability system; (c) An effective segregation of the IP raw materials and products within the supply-chain; (d) An analytical control plan based both on the risk assessment and a sampling strategy adapted to the supply-chain; and (e) Documented suppliers' approval and monitoring.

4.3 DISCUSSION

India is a producer of several agricultural commodities, fruits and vegetables. The country is among the top global producers of rice, wheat and sugarcane. Among the horticultural crops, India is a major player in the production of cashew nut, pepper, potato, tomato, spices, mango and tea. India is also a leader in the production of cotton and jute. Among the dairy and fishery agricultural products, India has a high position in the production of milk and egg. This sector suffers from several weaknesses however; the yields are among the lowest; almost 55% of the cultivated area depends on rain and overuse of ground water has led to a fall in groundwater level. The government warehousing capacity is inadequate. Trading of agricultural commodities is under the jurisdiction of state governments and each state has its Agricultural Produce Market Committee (APMC) which regulates physical trading of commodities. The APMC act requires the buyers and the sellers to assemble at pre-

[48] Eurofins-Identity Preservation- http://www.eurofins.com/food-and-feed-testing/food-testing-services/identity-preservation/

designated market places and is expected to facilitate the farmers to get competitive prices. In practice as mentioned earlier, farmers often do not get competitive prices. Moreover, to sell their produce they have to travel long distances to reach the APMC yards and “Mandis”. On account of APMC act, farmers cannot sell their products to ultimate buyers such as processors, exporters and retailers. As a consequence, the middleman takes away most of the economic benefits. Different state governments levy different rates of taxes on transactions carried out by the farmers in state government run APMC facilities. In order to ease such a situation, several private companies that deal with agricultural commodities such as ITC Agri Business Division (ITC-ABD), Cargill India, Nestle, Marico, Hindustan Unilever Limited and many others have resorted to contract farming in a few states. ITC designed its e-Choupal initiative to source wheat, soybean and other commodities from a large number of villages[49] which system has helped in better price recovery by the farmers for their produce. These companies have established procedures of implementing IP through SOPs, documentation and prescribed methods. ITC had designed its e-choupal initiative to source a few non-GM agricultural commodities like wheat, soybean and others from a large number of villages which initiative has not only enabled the farmers to receive stable prices for their produce but have also eased the introduction of IP procedures. Farmers have also received training in practicing such procedures. This has also enabled the production of standardized commodities.

However, commodity contracts have not yet taken deep roots as Indian individual land holdings are smaller resulting in smaller outputs of commodities, the farmers are constrained for money from banks and land up with receiving expensive capital from private money lenders. In such a situation, implementation of IP system at small farmer’s level becomes difficult to implement and such a system would lead to increased costs of the farmer’s produce.

With the introduction of commercial cultivation and trans-boundary movements of LMO FFPs, the question of identity preservation has become more sharply focused globally. A large number of countries including the United States, Canada, Argentina, Brazil, Australia, China, and India have allowed the commercial cultivation of LMOs which are developed using seeds invented through r-DNA technology. Many other countries still have conservative views on the authorization of cultivation of such

[49] Rajib P, Indian agricultural commodity derivatives market – In conversation with S Sivakumar, Divisional Chief Executive, Agri Business Division, ITC Ltd.,IIMB Management Review Volume 27, Issue 2, June 2015, Pages 118–12, http://www.sciencedirect.com/science/article/pii/S0970389615000154

crops in their soil such as Japan and several European countries. These countries have authorized imports of such GM foods with proper identity preservation and documentation within their territories. Simultaneously, several countries are instituting in-country labeling laws that require segregation and identification of seeds and food products developed through r-DNA technology. Labeling of packaged GM food has also been legislated in several countries.

In India, the Government has enacted mandatory labeling rules for GM packaged products. Since the agricultural commodities covered within the scope of the terms LMO/LMOs would be used as food, these products would attract the provisions of the enacted rules. These rules of labeling have not yet been adopted and applied on the use and marketing of GM products yet. Perhaps there are constraints in doing so with the existing legislation. The cultivating cotton seeds of *Bt* origin are approved and the seeds sold are truthfully labeled in India in accordance with the Indian Seeds Act, Rules and Procedures. Implementation of IP system for GM crops and GM food at all level in India would become difficult to implement with the existing legislation and such a system would lead to increased costs of the farmer's produce.

CHAPTER 5
IP SYSTEMS IN INDIA FOR SOYBEAN AND BASMATI RICE

5.1 INTRODUCTION

Identity preservation (IP) systems are generally required where purity of the crop is integral to capturing higher economic and trade value of a particular characteristic – usually driven by consumer demand or when a feature of a crop such as status of genetic modification is not acceptable to parallel supply chains/consumers. Two such products in the Indian context are basmati rice and soybean. In case of basmati rice, IP systems are relevant so as to retain the unique attributes of basmati rice viz. long size of grains and characteristic aroma, whereas in case of soybean, the IP systems are being implemented to ensure certification requirements as non-GM soybean. The status of IP requirements for both domestic and export supply have also been analyzed for both commodities. In case of soybean, the productivity in India is low and there are economic opportunities for introduction of GM soybean with concomitant use of target herbicide and hence the preparedness of the existing systems in case of introduction of GM varieties has also been discussed. On the other hand, in case of rice, India is presently a major exporter of basmati rice and commands a significant position in global trade. Introduction of GM basmati rice could affect these exports and hence, the IP systems must be stringent to ensure segregation and traceability. Accordingly, the information on the varieties being cultivated, indigenous production and Indian contribution in global context, domestic and export market, price and existing system of procurement and processing of both soybean and rice have been compiled. The chapter also includes an analysis of the information provided by Soybean Oil Producers Association (SOPA) and All India Rice Exporters Association (AIREA), coupled with literature search and field visits to farms, "mandis" and processing units.

5.2 SOYBEAN

The cultivated soybean, classified as *Glycine max* (L.), is an annual oilseed crop grown widely world over. As soybeans mature in the pod, they ripen into hard, dry beans. Although most soybeans are yellow, there are rare varieties which are black, brown or green coloured. The defatted soybean meal is used extensively as a cheap protein source for feeding animals and poultry. A small portion of the defatted meal goes in for human consumption.

5.2.1 Soybean varieties under cultivation

In India, all the soybean varieties cultivated are non-transgenic varieties. A large number of Soybean varieties have been approved for planting. Under the All India Coordinated Research Project on Soybean (AICRPS) system, 102 improved varieties have been developed till date under the domestic breeding programme. The list of varieties with their characteristics, state wise list and description of varieties with special characters is available with the ICAR-Indian Institute of Soybean Research (IISR)[50].

Indian Institute of Soybean Research also coordinates the breeder seed production to meet the national requirement of soybean seed. There are 40 varieties in the seed chain at present. However, interaction with the scientists at ICAR-IISR revealed that only about six varieties are extensively cultivated in large quantities and constituted about 95% of the total requirement placed to ICAR-IISR in 2016. These are JS-20-29, JS 2034, JS 320-24, RBS-2001-04, RKS-45 and DSb21. The list of approved varieties and the indent of breeder's seeds in Kharif 2015 and Kharif 2016 is placed at **Annex-1**. It can be seen from the Annexure that seven varieties namely JS 95-60, JS-335, JS-93-05, JS 97-52, MAUS-71, MAUS-158 and RKS-24 in 2015 constituted 97.6% of the total quantity indented and in the following year for 2016 in addition to the above seven varieties, another six varieties namely JS-20-29, JS 2034, JS 320-24, RBS-2001-04, RKS-45 and DSb21 had also been indented and the total indent of these thirteen varieties constitute 95.5% of the total.

ICAR undertakes production of "Breeder Seeds" through its Research Institutions, National Research Centers and it's All India Research Projects for different crops. For generating "Breeder Seeds" for Soybean, the ICAR institution is ICAR-IISR.This institution is mandated for handling several aspects of soybean including accessing genetic resources of soybean, carrying out research to increase the productivity and oil content including quality improvement in soybean, improvement in soya oilseed cake, technology transfer and coordination of multi-location trials to develop newer soybean varieties through All India Coordinated Research[50]**.**

"Breeder Seeds" are also produced through the National Seeds' Corporation (NSC), the State Farms' Corporation of India (SFCI), State Seeds' Corporation (SSCs) and

[50] ICAR Varietal Information System, http://14.139.54.69/VIS/Index.aspx

various Krishi Vigyan Kendras (KVKs). Once the “Breeder Seeds” are produced, it is required to produce the “Foundation Seeds” which are the progeny of “Breeder Seeds”. ICAR has entrusted the responsibility of production of “Foundation Seeds” to the NSCs, SSCs, SFCIs, State Department of Agriculture as also some private seed producers. Once the “Foundation Seeds” are produced, these are used for producing “Certified Seeds”. “Certified Seeds” are the progeny of “Foundation Seeds”. The Indian Minimum Seeds Certifications Standards (IMSCS) are to be met for the “Foundation Seeds” raised.

Soybean production zones are divided into Central zone, Maharashtra, Rajasthan, Karnataka, North Plain Zone, North Hill Zone and Jharkhand.

If soybean varieties are to be traded based on varietal characteristics then the thirteen varieties **(Annex-1)** would specifically require identity preservation by more stringent methods such as by molecular identification methods. ICAR-IISRhas conducted systematic scientific studies for identification of varieties whenever required by conducting molecular identity of specific cultivars. In normal practice this is not required and varieties are identified by morphological descriptors. Although each released variety has a specific identification number was related to its pedigree along with the name of the breeding centre and the year of release,IISR has developed techniques for molecular identity of commercial Indian soybean varieties so as to specifically identify any variety when required. Such molecular method of identification integrated with the morphological data is expected to become relevant in future. At ICAR Directorate of Soybean Research, Indore the scientists have developed molecular identification methods for six commercial Indian soybean varieties namely JS 95-60, NRC-37, NRC-7, JS 97-52, JS-93-05, JS-335, the details of which can be seen at **Annex-2**.

5.2.2 Soybean Production in India

According to the information published by the Soybean Processors Association of India (SOPA), the Indian production and yield of Soybean during the last 3 years from 2012 to 2014 had been[51] as shown in the following **Table 5.1:**

[51] SOPA Crop Report, http://www.sopa.org/crop%20report%202014.pdf, accessed on 21st June 2016

Table 5.1: State-wise Area, Yield &Production of Soybean-Kharif 2012, 2013 & 2014

	2012 Kharif			2013 Kharif			2014 Kharif		
Name of State	**Area**	**Yield**	**Production**	**Area**	**Yield**	**Production**	**Area**	**Yield**	**Production**
Madhya Pradesh	58.128	1116	64.858	62.605	691	43.262	55.462	1086	60.249
Maharashtra	32.130	1196	38.424	38.704	982	38.001	38.008	808	30.721
Rajasthan	9.870	1164	11.488	10.588	772	7.004	6.820	827	5.639
Andhra Pradesh	1.950	1050	2.048	2.840	815	2.315	2.720	975	2.652
Karnataka	2.000	1050	2.100	2.470	805	1.988	2.920	828	2.418
Chhattisgarh	1.520	1025	0.851	0.930	815	0.758	0.742	945	0.701
Rest of India	0.520	1015	0.528	0.630	805	0.507	0.693	925	0.641
Grand Total	**106.948**	**1139**	**121.655**	**120.327**	**788**	**94.768**	**108.834**	**959**	**104.366**

The production reported is not based on individual soybean varieties. Variety-wise production quantities were not available from any source. It was therefore obvious that varietal identification was not yet an important indicator for trade in India.

It can be seen from the above table that the total area under Soybean cultivation in India annually has been about 107-121 lakh hectares during 2012-14 and that the production had been ranging from 95-122 lakh metric tons with productivity per hectare ranging from 788-1139 kgs.

5.2.3 World Production of Soybean

The world production[52] of soybean is presented graphically in the following **Figure 5.1**.

[52] Leading countries based on the production of milled rice in 2015/2016, http://www.statista.com/statistics/255945/top-countries-of-destination-for-us-rice-exports-2011/

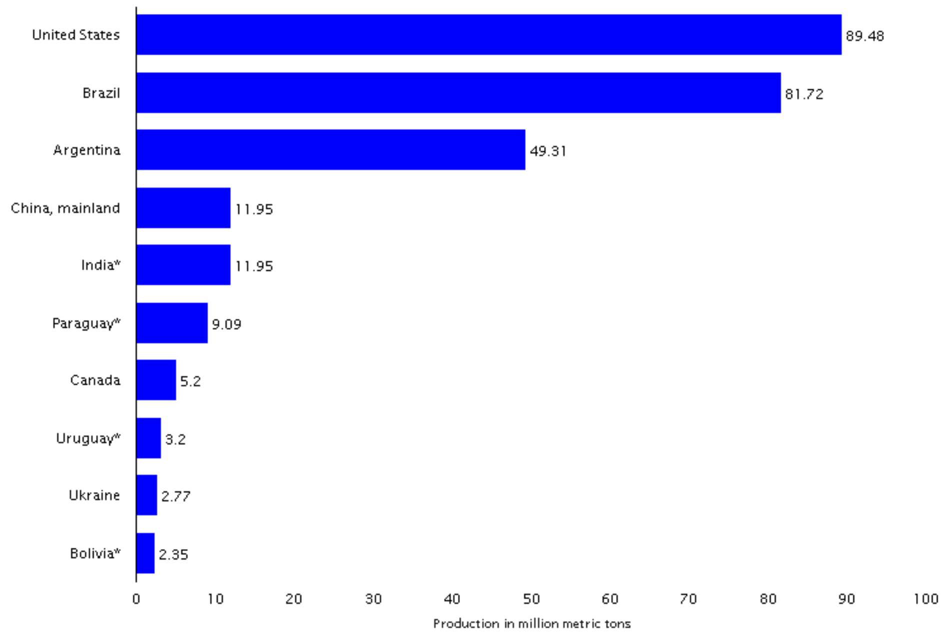


Figure 5.1: Worldwide production of soybean* in 2013 (in million metric tons)

**It can be seen from the above figure that Indian production is reported at 11.95 million MT during 2013 which is a reportedly higher figure of production than the figure reported by the SOPA at 9.48 million MT (Reference 3).*

It has been concluded from the above information at **Figure 5.1** that India is the fifth largest producer of Soybean, next to China **and is a comparatively smaller international player in terms of global production** USA, Brazil and Argentina are the first three largest and dominant producers of Soybean.

Soybean production is gradually going up world over significantly during the recent years as can be seen from the information provided above. This is firstly because yields per hectare have gone up significantly and secondly because the productivity of GM Soybean varieties (MT per hectare) has been more. In 2013, of the 107 million hectares deployed for Soybean cultivation, nearly 73% of the total land area was planted with GM Soybean (79 million hectares)[53].

At the present time, broadly three different types[54] of GM soybean varieties have been in use in commercial cultivation of which two varieties are two types of herbicide resistant soybean. GM soybean varieties containing glyphosate

[53] Genetically modified plants: Global cultivation on 174 million hectares, http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/257.global_gm_planting_2013.html

[54] Harrsion LA et. al, The Expressed Protein in Glyphosate-Tolerant Soybean, 5-Enolypyruvylshikimate-3-Phosphate Synthase from Agrobacterium sp. Strain CP4, Is Rapidly Digested In Vitro and Is not Toxic to Acutely Gavaged Mice, J. Nutr. March 1, 1996 vol. 126 no. 3 728-740, http://jn.nutrition.org/content/126/3/728.extract

resistant*aroA,* EPSPS (3-enoyl pyruvyl shikimate 5-phosphate synthase) gene obtained from Streptococcus pneumonia have been used by Monsanto in its soybean GM varieties. Glyfosinate resistant bar, PAT (phosphinothricin acetyl transferase) gene obtained from various Streptomyces spp. such as *Streptomyces hygroscopicus* and *Streptomyces viridochromogenes*have been used as selectable markers in plant genetic engineering work[55,56].

Protocols can be developed for ascertaining transgenic GM traits of Soybean in almost all kinds of Soy products and food that contain the DNA element in them. **Annex-3** provides information as an illustration to show that transgenic traits can easily be determined and quantified by amplifying the DNA obtained from such products.

5.2.4 Soybean Trade Scenario

Prices: The international prices of Soybean and its products are influenced by supplies and policies adopted by leading producer's viz. USA, Brazil and Argentina. The International and Indian prices of Soybean and Soya products in 2015-16 have been compiled from various sources[57,58,59,60,61,62]are depicted in **Table 5.2**:

Table 5.2: International and Indian prices of Soybean and Soya products in 2015-16

Soybean & Soy Products	Indian Price (USD per MT)	International Price (USD per MT)
Soy Grain	556	369
Soy Oil	647	580
Soy Meal	300	275

It can be seen from the above table that the international prices for soya and its products are cheaper than those prevailing in India. It is evident that the agricultural practices for soybean in major soya producing countries are therefore more economical. The major soya producing countries utilize GM Soybean varieties which are herbicide tolerant. In India, non-GM soya varieties are only cultivated. The

55 Mayer J et. al, Resistance to Phosphinothricin, 2004, CAMBIA Intellectual Property Resource, http://www.bios.net/daisy/bios/85/version/live/part/4/data
56 US Patent No. 5,077,399 (inventors: Brauer D et. al) , 31/12/1999, https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US5077399.pdf
57 Soybean price, http://www.commoditiescontrol.com/live-soybean-price.html
58 US Soybean price (per mt), https://ycharts.com/indicators/us_soybean_price_world_bank
59 Soybean Oil Futures End of Day Settlement price, http://indexmundi.com/commodities/?commodity=soybean-oil
60 Soybean Oil price, http://indexmundi.com/commodities/?commodity=soybean-oil&currency=brl
61 Soybean Meal price, http://indexmundi.com/commodities/?commodity=soybean-meal
62 Soybean Meal price, Nasdaq, http://nasdaq.com/markets/soybean-meal.aspx?timeframe=7d

reasons for lower international prices of soybean and its products compared to Indian prices are due to the use of GM Soybean seeds internationally, which results in lower cost of production. Interestingly however, the productivities of non-GM Soybean versus GM Soybean indicate that non-GM varieties yield more as discussed later although the overall cost of production of GM Soybean gets reduced due to saving in the labor cost of tilling the land; tilling requirements are substantially lower for GM Soybean cultivated along with the use of chemical herbicides.

As only non-GM varieties are grown in India, the cost of soybean and its products derived from Indian cultivars is high, as compared to international prices.

Soybean Exports Issues:

India has been a supplier of non-GM Soybean and its products in the international market. However, the Indian prices are not competitive. Moreover, non-GM Soybean and its products are also available from multiple sources in international trade. Brazil is a major supplier of non-GM Soybean and its products. Brazilian GM as well as non-GM Soya is extensively being exported to China besides to other countries. In 2010, nearly 56% of Brazilian Soya was exported to China[63]. Because of the presence of such giant contenders of non-GM Soya suppliers, Indian export of non-GM Soya and its products is not becoming quite competitive. India has therefore to be contented majorly with its trade within the country unless the productivity is increased and the costs are substantially cut down. As the GM soybean has not yet been approved in the country, the identity preservation presently relates to authentication of non-GM for export purposes.

5.2.5 Domestic market

As a large number of non-transgenic Soya varieties are being cultivated in the country,efforts were made to understand and study if the varietal identification of the produced Soybean lines can be kept up and made available from production to consumption points.

[63] An overview of the Brazil-China soybean trade, http://www.nature.org/ourinitiatives/regions/southamerica/brazil/explore/brazil-china-soybean-trade.pdf

5.2.6 Soya Procurement and Processing in India

Soybean procurement and sale in India is predominantly through "Mandis"(Wholesale market place)which are transaction establishment and infrastructure created under different State Marketing Acts and managed locally by constituted Agricultural Marketing Committees (APMCs). "Mandis" serve as the conduit for "first transaction" between the farmers and the initial buyers where purchase and sale are essentially through the process of auctioning and bidding under certain conditions. Several technology-based infrastructure has been created in many 'Mandis" to enable the farmers to receive more fair prices such as installation of electronic weighing bridger (to minimize weighing malpractices), improvement in communication by the development and installation of SMS-based registration system to manage systematic arrivals of cargos during both government and heavy private procurement season etc. Transactions through "Mandis" are essentially to enable the farmers to secure fair prices. Transactions are also held in private channel through contracts where the organized buyers enter into contracts with several farmers on certain terms such as supplying of critical inputs and imbibing good management practices in order to receive quality soybean grains having premium value.

After obtaining the soybean consignments in the storage area of the processing sites, the soybean processing mills carry out the processing operations which are substantially standardized unit processes and unit operations. Based on literature survey and interaction with stakeholders viz farmers, traders and industry representatives, it was noted that Soybean processing steps in a typical Soybean mill in India are depicted in the following **Figure 5.2**:

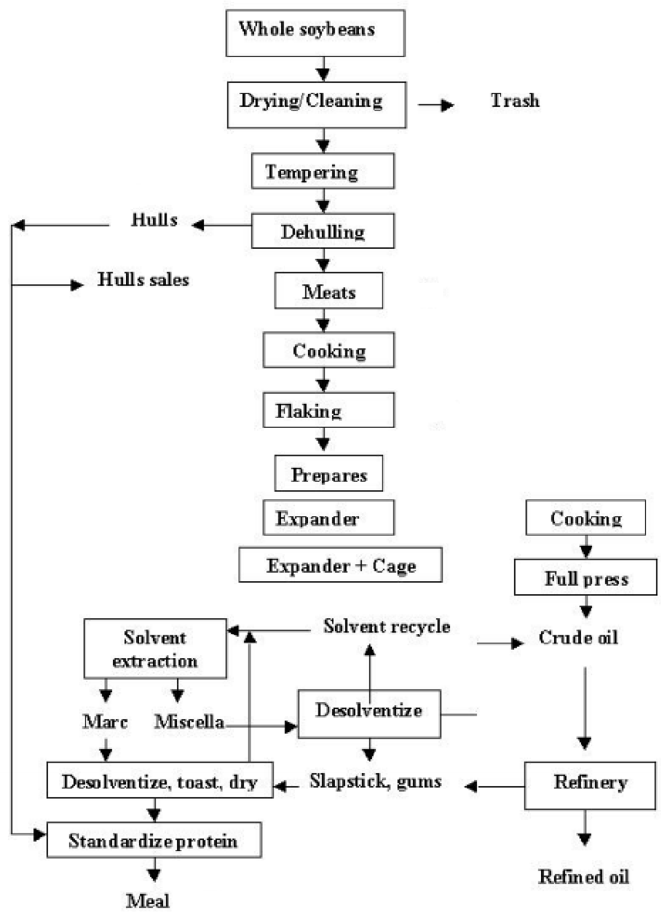


Figure 5.2: Soya processing steps in a Soybean mill

To ascertain the above process and understand the steps of procurement and processing, a visit was undertaken to Indore in Madhya Pradesh, one of the leading soybean growing State. The key observations from visit to the *SanyogitaGanjMandi, Indore and Prestige Group of Industries, Indore* in the month of October 2015 are elaborated below.

(i) **Visit to Sanyogita Ganj Mandi:** It was observed that the farmers brought their produce in different transport vehicles starting from bullock carts to Lorries. The consignments were dumped on the Mandi floor and sale was made by auction. Large consignments purchased by the traders/merchants were huge heaps of soybean where different varieties got mixed up. Even when consignments of one supplier were sold out, the buyer bundled it up with its other consignment of soya purchases and the entire heap was then bagged in gunny bags. The purchased soybean packed in gunny bags were loaded in trucks and taken away by the purchaser. The following pictures show the condition of trade of soybean in Indore soya mandi:

1. Empty Mandi one view

2. Empty Mandi another view

3. Farmer emptying his produce for sale

4. Farmer emptying produce-another view

5. Farmer stacking his produce for sale

6. Farmers' produce emptied for sale

7. Another farmer mixing varieties for sale

8. More close view of one Soya dump for sale

9. Handful of one Soya dump for sale

10. Sold soybean being packed for transfer

11: Small dump transferring after sale

12: Large dump after sale being packed

13: Sold dumps bagged for transfer

14: Sold dump being transferred by Lorry

15: A Buyer

16: Another buyer transferring his goods

Visit to the Mandi revealed that all varieties get mixed up. Speaking to some of the buyers revealed that they were not interested in purchase of any specific variety by name. They looked at the quality of the material by visual inspection and offered bid for prices when auctioned.

It was clear from the transactions and activities in the Indore Mandi that there was no segregation for varieties nor was there any eagerness shown by the traders for doing so as sale and purchase were based on physical look of products only. Obviously therefore similar looking materials were bundled up for easing the trade practices. Identity Preservation of non-GM soybean varieties was in no way an issue of trade in the Indore *Sanyogita Ganj Mandi*.

(ii) **Visit to Prestige Group of Industries:** Whole Soybeans received from the Mandi are reserved in a godown in the factory. A batch comprising of 100-1000 tons of processing per day is usually the capacity of various processing mills. The processing unit visited by us had a capacity of 300 tons processing capacity per day of 24 hours.

From the godown, the batch weight of soybean preserved in gunny bags is collected and dumped in a feed area. From the feed area, the unprocessed soybean is carried by chain conveyors into the cleaning machinery where soybean is separated from light weight as well as heavy weight materials besides adhering dusts. The cleaned soybean is then subjected to crushing. The crushed beans are then separated from the hulls and the cleaned but broken pieces of soybean are thereafter steam-cooked followed by pressure-expansion in Expanders. The expanded materials are then subjected to extraction by using hexane on a chain conveyor like extraction unit. The pressure expanded soybean flakes rest on a moving chain conveyor and hexane is spread from top to percolate over flakes of soybean, thereby extracting the oil from it. The oil with hexane is separately collected, the solvent removed and reused. The crude oil is then sent for refining. The gum generated in the refining process is used for producing soy-lechithin or sold out. The unit we visited produced only unrefined soybean oil. The purification process was stated to be carried out in another unit, situated elsewhere. The soy cake devoid of oil is heated with steam to remove the last traces of solvent and then used for size separation, standardization and packing into a standardized soy meal. For producing edible grade soy meal, the procedures for cleaning the raw soy as also further cleaning of hulls after breaking the seed are more stringent than when de-oiled soy cake are converted into animal grade feed material. Some photographs taken at different phases of the operations are placed below:

A batch collected from godown from

Bags opened and soybean bulked together

processing


Conveyor area transporting soya for processing

Every hour processing sample analyzed physically


Soy processing machine removing dust

Soy processing machine cleaning soy


Processed cleaned soybean

Stones separated from Soybean

Clean soybean being crushed

Crushed soybean with hulls

Broken soybean cleaned from hulls

Soybean hulls separated from soybean

Steam heated soybean cooking pressure cooker

Soybean flakes transported to oil extraction unit

De-oiled soybean flakes

De-oiled flakes size separated

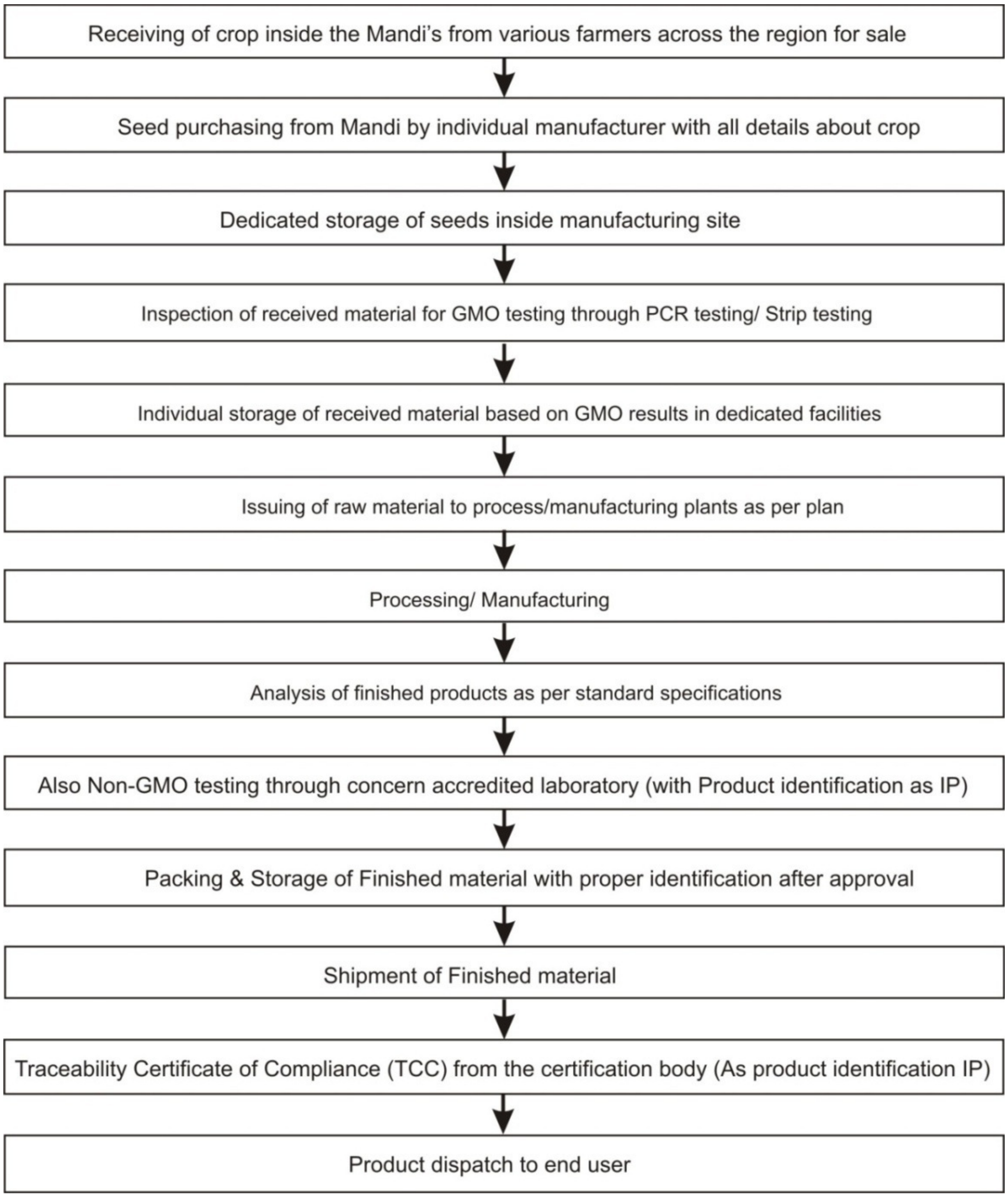
Size separated soy cake packed for sale

Finished fifty kgs bags of processed soy for sale

From the visits to the ‘Mandi” at Indore it was evident that rigorous segregation was not carried out between and among the consignments received for auctioning and sale. Chances of ‘mixing’ among the traded varieties were profound. From the visit of the processing unit of soybean at Indore it was found that the company was not carrying any genetic testing of neither the input soybean grains nor the finished consignments for genetic testing to ascertain about the transgenic trait. As India has not yet permitted the use of GM Soy for use in the country in any form, perhaps the positions observed were natural. However, genetic methods are available to test GM traits if required in the trade practices as mentioned earlier.

5.2.7 Systems for Non-GM Certification of Soybean

As per information provided by SOPA, it has been indicated that wherever required, samples of soybean as well as processed materials are subjected to testing to ascertain in status of GM content in consignments. The steps followed in the industry requiring to meet buyers specifications where genetic testing necessitates the establishment of GM/GM free status of the consignment is carried out as per SOPA. SOPA provided a flow chart as given below indicating the steps that are being followed, where required by the soybean processing units.



It is evident where such steps are rigorously followed, the consignments can be certified to be GM free. For ensuring identity preservation in respect of GM status, the manufacturers carried out testing the input materials as well as the processed lots of soybean meal used as animal grade soybean or food grade soybean as flakes, powders and other forms are being tested in their own laboratory or in SGS Indian labs or in European labs like Genetic ID, Nofa Lab, Eurofins etc. so as to comply with the requirements of the buyer, where required. Export Inspection Council (EIC) has been authorized the Government of India for issue of non-GM certificates for various products including soybean. Therefore, the traceability certificate of compliance (TCC) as has been claimed in the flowchart of SOPA appears to be in place for companies carrying out identity preservation in the above way.

5.3 BASMATI RICE

5.3.1 Rice

Rice is a semi-aquatic annual grass plant which produces rice seeds or paddy on maturing and which on milling produces milled rice. Rice is the staple food of an estimated 3.5 billion people in the world. Of the about 22 species of rice belonging to the genus *Oryza,* only two species are cultivated for human consumption which are *O. sativa* and *O. glaberrima. O. sativa* is the rice mostly grown all over the world of which *O. sativa indica*is the non-sticky, long grain Indian rice while *O. sativa japonica* is the sticky short-grained japonica or sinica variety grown in China, Japan and other South East Asian countries. *O. glaberrima*is rice grown primarily in African countries[64,65].

5.3.2 Leading global producers of rice

The global milled rice industry in size in 2012 was about 459 million MT valued at USD 275 billion. Basmati rice accounted for 6.7 million MT valued at USD 5.8 billion, which was 2.1% of the global market. India was the largest producer of basmati rice and Indian production accounted for nearly 72% of basmati rice which was about 4.8 million MT valued at USD 4.4 billion[66].

Leading producers of milled rice in 2013-14 was as under **Figure 5.9**, where India accounted for 105 million MT, next to China[67].

[64] Oryza sativa, WIKI, https://en.wikipedia.org/wiki/Oryza_sativa
[65] Oryzaglaberrima, WIKI, https://en.wikipedia.org/wiki/Oryza_glaberrima
[66] Indian Basmati Rice Industry , http://horizonresearchpartners.com/wp-content/uploads/2012/08/Indian-Basmati-Rice-Industry-7-26-12.pdf
[67] Leading countries based on the production of milled rice in 2015/2016, http://www.statista.com/statistics/255945/top-countries-of-destination-for-us-rice-exports-2011/

Leading countries based on the production of milled rice in 2013/2014 (in 1,000 metric tons)

This statistic shows the top countries based on the production of milled rice in 2013/2014. In that crop year, China produced some 142 million metric tons of milled rice. Thus, China was the world's largest producer of milled rice.

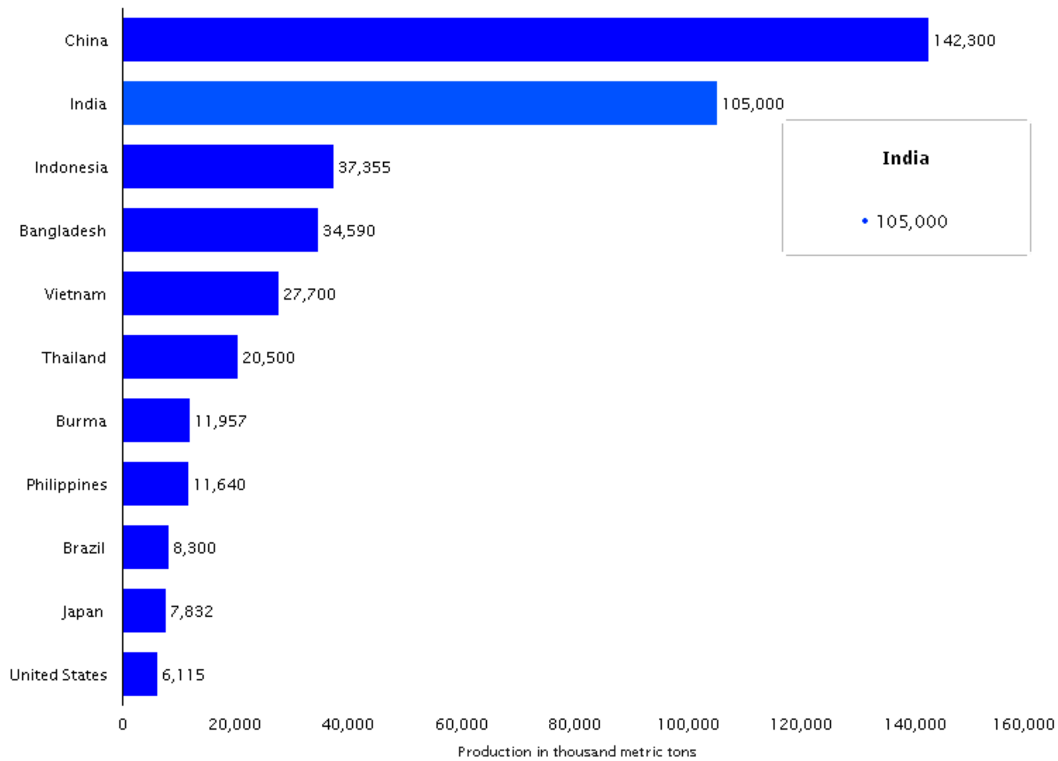


Figure 5.9

5.3.3 Basmati Rice

The term "Basmati" is protected under Indian "Geographical indications of goods (Registration and Protection) Act, 1999" and thereby according to the provisions of World Trade Organization, fragrant rice grown outside of Indo-Gangetic area cannot be termed as "Basmati" [68].

For India, Basmati rice among all other varieties of rice is a niche product. Rice grains are commodity items for trade. However, Basmati rice is a specialty prized grain. Basmati rice is a harmonious combination of extra long slender grains and exquisite aroma. During cooking, the volume expansion is especially noticeable through its linear kernel elongation. The cooked rice is appreciated for its fluffiness

[68] Plant Variety Registry related information, http://plantauthority.gov.in/PVR.htm

which property is appealing to taste and better mouth feel. The cooked rice has also a longer shelf life.

India exports large quantities of basmati rice to various countries. The exports in quantity and value during the last three years have been collected and compiled and are placed at **Annex-4.** The information placed at **Annex-4** shows that the annual average exports of basmati rice during the last 3 years had been 3638498 MT of average value of Rs. 2543203 lakhs, or an average export selling price of Rs. 69.90 per kilo.

5.3.4 Indian Export Of Basmati Rice Compared to total Rice Exports

The export of basmati rice compared to the total export of rice from India during the last 3 years had been as shown in **Table 5.3(A)** below:

Table 5.3(A): Export of Basmati Rice compared to export of rice during last 3 years

Year	Basmati Rice Export Qty (MT)	Non-Basmati Rice Export Qty (MT)	Basmati Rice Export as % of Total Rice Export
2012-13	3459236	6687991	34.1
2013-14	3753974	7133183	34.5
2014-15	3702284	8274046	30.9

It can be seen from the above that basmati rice exports contribute to more than 30% of the total rice exports from India. The average value is also more than Rupees Twenty Five Thousand crores.

The sizeable export of basmati rice justifies the need for **identity preservation** of the product in the international market as also in the domestic market.

5.3.5 State-Wise Indian Production of Basmati Rice

The total production of basmati rice in quantity in India during the last 3 years up to 2014 was as under in **Table 5.3(B)** [69]:

[69] State-wise Basmati rice production, http://www.airea.net/page/60/statistical-data/state-wise-basmati-rice-production

Table 5.3(B): Total production of basmati rice in quantity in India during the last 3 years

STATE	2014	2013	2012
Punjab	3498.88	2292.75	2282.15
Haryana	3701.88	2898.98	2261.26
Uttar Pradesh	1260.69	1270.09	1428.48
Uttarakhand	66.41	54.16	53.9
J&K	240.77	92.66	96.13
Himachal Pradesh	2.15	3.4	5.7
Delhi	3	4.09	6
Total	**8773.8**	**6616.1**	**6133.6**

(State-wise production in thousand tones)

It could be seen from the data in the above table and the quantity of basmati rice exported as provided in earlier tables, that a sizeable quantity of production is actually exported. India has therefore a great stake on the trade of basmati rice in the international market.

5.3.6 Varieties of Cultivated Basmati Rice in India and Pakistan and Other Similar Varieties

Several varieties of basmati rice are cultivated. Approved Indian varieties of Basmati rice as notified under the Seeds Act, 1966 are: Basmati 217, Basmati 370, Basmati 386, Haryana Basmati-1, Karnal Local/ Taraori Basmati, Kasturi and Mahi Sugandha, Pusa Basmati-1, Pusa Basmati 1121, Pusa Basmati 1509, Punjab Basmati-1, Ranbir Basmati and Type-3 (Dehradooni Basmati)[70,71,72].

According to one recent estimate, the global demand of basmati rose by 10.5% annually during 2001-12 as compared to the growth of whole rice at 1.2% during the same period. This is primarily because of the Indian development of PUSA BASMATI 1121, which is an evolved variety and which has substantially contributed to increased earnings of farmers[73].

[70] APEDA: http://apeda.gov.in/apedawebsite/SubHead_Products/Basmati_Rice.htm
[71] IARI: http://iari.res.in/?option=com_content&view=article&id=649&Itemid=1621
[72] Hindu Businessline:http://www.thehindubusinessline.com/economy/agri-business/the-next-billiondollar-basmati/article5542081.ece
[73] Indian Basmati Rice Industry, Horizon Research, http://horizonresearchpartners.com/wp-content/uploads/2012/08/Indian-Basmati-Rice-Industry-7-26-12.pdf

The basmati varieties cultivated exhaustively in the neighboring country in Pakistan are: PK 385, 1121 Extra Long Grain Rice, Super Kernel Basmati Rice and D-98[74].

In several other countries, of late, long grain aromatic rice is being cultivated and these are becoming a source of competition for sale in the international market. In United States, a variety of rice having basmati like smell and called as Texmati is grown. In Kenya, another rice variety called Pishori or Pisori is grown[75].

There are thus several suppliers of Basmati rice or Basmati-like rice in the international market. It is in this context therefore that there is a need to develop techniques to certify the basmati varieties grown in India so that these can be properly identified and can be certified as **genuine Indian Basmati rice**.

5.3.7 Indian Basmati Rice Notified by Govt. of India under Seeds Act

Presently in India, several varieties of Basmati rice have been recognized by the Government of India under Seeds Act, details of which can be seen[76] at **Annex-5.**

It is anticipated that in India all or most of the above varieties grown in the country are registered with the Protection of Plant Varieties & Farmers' Rights Authority, India77. As and when registered, there would be adequate documentation of each variety through the criteria of Distinctiveness, Uniformity and Stability (DUS) as provided under the Indian law.

In Indian context, besides DUS criteria, Identity Preservation of Basmati rice by fool-proof genetic identification methods assume great significance in trade as India has a strong business interest in international trade for this commodity.

5.3.8 Practices followed for maintaining IP in Basmati Rice

The All India Rice Exporters' Association (AIREA) had submitted a report to Ministry of Environment, Forests and Climate Change, Government of India recently, which report was made available to SOMPRADIP Publishers and Consultants, New Delhi

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[74] Basmati Varieties and Hybrids, WIKI, https://en.wikipedia.org/wiki/Basmati#Varieties_and_hybrids
[75] GI Act, http://ipindia.nic.in/girindia/GI_Act.pdf accessed on 21st June 2016
[76] Compiled information obtained from Dr. Anupam Dixit, Chief Scientist and Station In-charge, Basmati Export Development Foundation (under the aegis of APEDA, Ministry of Commerce, GOI), Meerut
[77] US Patent 5663484A (inventors: Sarreal ES et. al, publication date: Sep 2, 1997), http://www.google.com/patents/US5663484

in August 2016.The report is based on a survey conducted by AIREA involving interaction of about 20 Surveyors from AIREA with some 20,000 farmers covering about 400 villages; also there was interaction with nearly 200 representatives of rice millers. The major areas covered were Punjab, Haryana, Western UP and Delhi. The AIREA report also provided information about rice production including basmati rice in the country. The report covered issues concerning the farmers, rice millers and merchants regarding implementation of an IP system for Basmati Rice.

It was brought out from the AIREA study on issues concerning the **seed source** that some farmers of Haryana and Western UP were more aware of genuine seed sources and the more scientific procedures for **seed treatment** before sowing than farmers of other regions like Punjab. Up to 75% of all farmers purchased seeds from private agencies while a small group of 10-15% used their own seeds or obtained these from other farmers.

The AIREA study stated that the basmati paddy seed varieties were being presently identified by the farmers by **visual methods of assessing the size and shape** in Punjab and Haryana but in other areas like Uttar Pradesh, the farmers were and are dependent on the tag on the purchased seeds. Neither of these practices is adequately scientific even though the farmers have exhaustive prior experience. For those farmers who depended upon the tag on the seeds level, they were entirely going by trust on the issue of procurement of genuine seeds for cultivation.

The report of AIREA does not specifically include information about maintaining molecular methods of IP at any level. While the farmers who were growing Basmati Rice from purchased seeds from “genuine sources”, such seeds are anticipated to be truthfully labeled in accordance with Indian Seeds Act. However, such seed lots were not subjected to the conduct of any genetic testing method. As regards sale of rice, it has been indicated that more than 85% of the farmers from Punjab sold their produce in grain market while from other areas farmers sold their produce through agents. The merchants traded on rice in the marketplace based on phenotypic assessment of the produce available in the market (rice length, diameter and color) as also the aroma of the cooked rice.

5.3.8.1 As in the AIREA report there was no indication about which molecular methods of testing were practiced at least for exportable consignments of basmati rice, there was a need to ascertain if such methods of testing were demanded by the buyers from different countries especially from Europe, USA and other rich countries. Therefore, in 2017, a set of questionnaire was developed in consultation with SOMPRADIP Publishers and Consultants, New Delhi and BCIL; these questionnaires were issued by the MOEF & CC to AIREA in February 2017, requesting the latter to collect information from specific Basmat processing units who were also major exporters. AIREA had collected the information from four industry players which can be seen at **Annexure-A**. These information have been collated and integrated in **Annexure-B**.

5.3.8.2 It can be seen from the collated information (Annexure-B) that procurement of Basmati paddy is made from Mandis by these companies. Procurement is not carried out variety-wise. While exporting Basmati rice, the specific requirements of the importing countries include descriptin of size, shape, appearance as well as aroma of grains and maximum limits of pesticide residues. DNA fingerprinting certification is required by certain countries only. Companies obtain certification of authenticity of basmati rice from the Export Inspection Council (EIC) of India. Certificates are also generated from private testing laboratories which are several in numbers in the country. The total cost of testing on an average for the certification purposes has been stated to be Rs. 100 per tonne of basmati rice, which cost is very small, about 0.2% of the present selling price of basmati rice. The testing costs are entirely borne by the manufacturer/processors.

5.3.8.3 It appears from the above that the Identity Preservation methods for Basmati rice including genetic identity preservation costs are very small part of the selling price of basmati rice and therefore these costs are absorbable within the processing costs.

5.3.8.4 Basmati rice quality continues to be assessed by sniffing the aroma of cooked rice. In addition the original length along with elongation after cooking is also measured. Further, often the taste is also assessed. These factors are taken into consideration in the trade for valuing the quality. The identities of traded varieties in the market during the season by the above methods along with determination of moisture percentage are the current practices followed in trade. Basmati rice phenotypically is a combination of extra long slender grains with exquisite aroma. During cooking the rice has high volume expansion and linear kernel elongation. Determination of aroma by sniffing, which is practiced presently is neither accurate nor scientific. Moreover, this method is also likely to imbibe personal bias. Nevertheless, this practice is being followed presently. All these are physical traits which are primarily observation based without the use of sophisticated scientific instruments for quantification. *These processes of IP would not enable the identification of target varieties at the genetic level.*

5.3.9 Visit to Processing Unit of Basmati Rice

In order to ascertain the practices adopted in Indian manufacturers of Basmati Rice for export purposes as also for sale within in India, a visit was undertaken to M/s Best Foods, Karnal in the month of December 2015. The findings on the basis of the visit are embodied below:

- The processing unit of Best Foods Ltd. at Indri district of Karnal in Haryana was visited to have a first-hand impression about the company. Best Foods is presently the largest exporter of basmati rice and has created largest production capacity of basmati rice in the world. The company has strong presence in nearly 150 government monitored grain markets and procures quality paddy at rational prices. The company enjoys “preferred buyer” status among farmers and it has established itself among the farmers as procurers of paddy offering superior terms. The company has a state-of-the-art facility which was visited. The plant has integrated operations from procuring of paddy, maturing, processing to packaging, branding and distribution of all traded varieties of basmati rice. They also have a captive power plant where power is generated from “own paddy husk burning” in the boiler.

- Basmati rice is exported in various parts of the world by the company with maximum export being in the Middle East countries. Their products are widely accepted in India and in overseas markets like Middle East, Iran, Europe, Africa, CIS countries, Australia and USA. Besides Basmati rice, the company also exports all other types of Indian origin rice. Basmati rice is exported in consumer packs of 1 kg, 5 kg, 10 kg & 25 kg in their brand. They also process and pack Basmati rice in private labels when such situation arises. Among the major finished rice packs traded by the company include traditional Basmati Rice, 1121 Basmati Rice, Pusa Basmati Rice, Super (Shabanam) Basmati Rice, Sharbati Rice, Parimal rice (PR 11/14 , PR 106), IR 36/IR 64 and SonaMasuri.

- The company has created a capacity of processing of nearly 144 tons of paddy per hour (45000 MT of processed rice per month) in an area of 100 acres of land with modern factory building space and a 10 megawatt co-power generation unit. The company has further created sound water harvesting and purification system and has established an effluent treatment plant. The procured paddy as well as the processed rice is hygienically maintained in storage. For paddy milling, they have procured the technology from Satake International, Japan and Bulher, Germany while for final product packing they have inducted technologies from Guiall Pack, Lee Pack Nichrome and CIEA Metal Detection technology to produce rice of best quality. The technical knowhow and the technology deployed are most contemporary.

- In the year 2015, the company generated revenue of INR 27.38 billion. The company has long term track record of growth and value creation and their profitability track record is excellent. The company presently employs approx. 500 people who are directly on company's payroll.

- For Identity Preservation (IP) of all grades of Basmati rice as well as non-Basmati rice, the company adopts sound system in order to enable them to trace the quality of the product at each stage of handling. Before the commencement of procurement season, a survey of paddy fields is conducted by companies Procurement cell employees to assess the quality and availability of good quality paddy. A sample survey is also conducted in all the "Mandis" and the samples are collected on frequent basis through appointed dealers so that the quality of the procurement is of high order. Visible test of paddy is conducted for assessing the desirable characteristics such as grain size, broken grains and moisture content before procurement. Paddy is procured from all five Basmati producing states namely Haryana, Punjab, UP, Rajasthan and Madhya Pradesh. Company procures materials from 181 "Mandis" with 200 procurement Centers. Through computer network, the procurement from "Mandis" and their Vendors are recorded and such records are also preserved with the company. From such records, the history of any paddy batch procured can be traced. The company has capacity to store 10 million bags of paddy and state-of-the-art warehouse to store 100,000 MT of finished rice.

- Once the procurement is over and the material is received in the godown (grain warehouse) every consignment is subjected to lab testing where specified types of parameters such as moisture check, chalk test etc. are conducted. Samples are then processed in the lab to determine yield and after-cooking characteristics. After the paddy is converted into rice, the quality of rice is also checked for various desirable characteristics such as grain size, grain length, grain color, aroma, cooking characteristics etc. The pesticide residue is also determined. In some cases, depending upon buyers' requirement, genetic testing is also conducted. Pure Basmati samples are required to have genetic purity of 95% and above which means that non-Basmati rice contamination can be tolerated only up to 5%. No testing is carried out for GM traits by any genetic testing method in samples.

Clearly there is a gap in the assessment methods carried out presently as these methods are not addressing the accidental presence of GM traits in rice. As the GM trait in rice is anticipated to get introduced because of brisk research in this area in several parts of the world including India, there is a great need to be capacitated to assess GM trait in rice samples through genetic methods.

5.3.10 Requirement of Scientific Approach for IP in Basmati Rice

In addition to physical parameters, it is important to include scientific approaches for an effective IP system for Basmati Rice as indicated below:

- **Measurement of 2-acetyle-1pyrroline**

  The aroma in basmati rice is mainly due to the presence of 2-acetyl-1-pyrroline (2-AP) with content varying between 150-800 parts per billion[78]although other volatile components might also be contributing to aroma. An analysis of basmati aroma carried out earlier by gas chromatography indicated the presence of 72 volatile compounds although 2-AP was the main component contributing to aroma. It is necessary therefore that for the measurement of aroma, more scientific methods relying upon instrumental methods of assessment should be introduced.

[78] Tava A et. al, Aroma of Cooked Rice (Oryza sativa): Comparison Between Commercial Basmati and Italian Line B5-3, July/August 1999, Volume 76, Number 4, Pages 526-529, http://dx.doi.org/10.1094/CCHEM.1999.76.4.526,

- **Genetic Authentication of Basmati Lines**

Quality and yield improvement in basmati rice can come from right genetic selection, cross breeding and insertion of transgenic coding for specific quality traits. The natural genetic lines of the selected varieties as well as of the cross bred hybrids can be determined by DNA testing methods. Phenotypic methods of testing would have to be augmented with appropriate nucleic acid testing methods. This is also relevant to authenticate the origin of basmati rice when traded internationally. Further, while developing basmati rice by genetic selection and crossing many a times the fragrance gets erased though better varieties get produced in terms of other traits such as elongation, slenderness and taste. Yet identity of such new lines/hybrids can be linked to original basmati parental lines only by genetic testing methods. In such instances also genetic testing becomes very relevant.

DNA testing methods using amplified fragment length polymorphisms (AFLPs) and simple sequence length polymorphisms (SSLPs) has been developed to distinguish between various traded rice[79]**.** Polymerase Chain Reaction (PCR) based amplification technique of microsatellite sequences of rice has been developed using a set of forward and reverse primers and the technique has been used as a cost effective and fast method to establish the authenticity of basmati rice in non-basmati rice ground products[57].

There are several initiatives taken in the country for undertaking and promoting programs for Basmati rice for its development, identification and commercial promotion. One such initiative was the creation of Basmati Export Development Foundation (BEDF) created in 2002 as a registered society. This initiative was promoted by the efforts of Agricultural and Processed Food Products Export Development Authority (APEDA), Ministry of Commerce, Govt. of India and Basmati Export Trade. The mandate of BEDF includes development of application technologies and integration of activities of diverse stakeholders such as farmers, millers, traders and exporters for strengthening the supply chain of authentic basmati rice[80]. BEDF has established a modern world-class laboratory for quality authentication by DNA testing methods. The laboratory also

[79] Bligh HFJ et. al, Using Amplified Fragment Length Polymorphisms and Simple Sequence Length Polymorphisms to Identify Cultivars of Brown and White Milled Rice, Crop Science , Vol. 39 No. 6, p. 1715-1721, https://dl.sciencesocieties.org/publications/cs/abstracts/39/6/1715
[80] BASMATI EXPORT DEVELOPMENT FOUNDATION,http://apeda.gov.in/apedawebsite/about_apeda/bas_ex_dev_found.htm

undertakes assessing Pesticide residues, detection of heavy metals and aflatoxins in rice samples. The laboratory is set up within the premises SardarVallabh Bhai Patel University of Agriculture & technology (SVBPUAT), Modipuram, Meerut, Uttar Pradesh. Discussion with Dr. Anupam Dixit, Chief Scientist and Station In-Charge of BEDF in December 2015 revealed that of the 23 Basmati rice varieties notified under Indian Seeds Act, 1966 the traditional varieties such as Basmati 370, Bas 386, Type 3, Taraori and Ranbir are genetically very close with less genetic variations among them. As a result, it is difficult to distinguish one from the other even at the genetic or DNA level. These varieties are less traded when compared with the "Evolved Basmati" varieties which include Pusa Basmati 1, PB-1121, PB-1509 Kasturi, Mahi Sugandha etc. Presently, Microsatellite markers are used for identifying and assessing the quality of such "Evolved Basmati" varieties by genetic testing methods where assessment is made on the presence of microsatellites of DNA stretches of 2-6 nucleotides repeated in tandem such as **CACACACACACACA**.. BEDF has developed DNA profiles data of all the notified Basmati varieties with their pure seeds along with certain non-Basmati varieties having phenotypic look of Basmati varieties such as Sharbati, Parimal, Pusa Sugandha-2,3& 5. BEDF is an accredited laboratory and has obtained the "Certificate of Accreditation" from the National Accreditation Board for Testing & Calibration Laboratories (NABL) for its DNA testing capabilities; BEDF is an authorize centre for testing of Basmati rice samples drawn from Basmati rice export consignment at different custom stations, located at various ports in the country. The genetic testing conducted by BEDF for any Basmati rice sample is a Polymerase Chain Reaction (PCR)-based method in which specific regions of DNAs containing SSR and microsatellite sequences from samples are amplified using predefined primers. After amplification, the amplified products are separated by a laser induced fluorescence detection system based on capillary electrophoresis.

For conducting a PCR based testing, the BEDF charges Rs. 4000 per sample. The lab is capable of handling 24 samples at a time. Test reports are made available to the client within 6 working days from the date of receipt of the sample. The charge is very nominal when compared with the charges made by private laboratories where they charge as much as Rs. 10000-15000 per sample. BEDF charges are low perhaps because BEDF is a non-commercial lab. However, it is to be remembered in this context that quality control charges for a large Basmati rice production outfit works out to about 0.8-1.2% of the cost of production of Basmati rice for a modern Basmati production unit such as Best Foods Ltd. and therefore such charges of samples do not materially affect the cost of trading consignments which are in crores of rupees. It is further mentioned in this context that European countries do not accept any Basmati consignment from India if does not contain a DNA testing report; any Basmati consignment by DNA testing has to provide information that the consignment does not contain more than non-Basmati rice as contaminants. Discussion with BEDF revealed that the commercial Basmati samples available in Indian market sometimes contain 30-60% of non-Basmati rice. Such “contamination” is perhaps deliberate to reduce the unit price of “Basmati rice” in the open market to be “price competitive”.

Proving the authenticity of basmati rice in a commercial basket is an important procedure as basmati rice fetches high prices in the rice trade market. As mentioned above, quantitative nucleic acid based testing methods exist which can be used for identifying and authenticating Basmati rice varieties. However, methods are not yet in place for the assessment of GM traits in Basmati rice.

5.3.11 Testing requirements in case of introduction of GM rice

As regards GM basmati rice, presently since there is no genetically modified rice in the commercial arena, there is no concern about the presence of GM trait in rice trade at the moment. However, as mentioned earlier, this situation may change worldwide because of considerable research carried out for the development of GM rice including GM basmati rice[81].

In rice, several studies have been made to generate transgenic plants to impart biotic and abiotic stress tolerance utilizing a wide range of constructs as has been summarized in **Annex-6.**

It is anticipated that some such transgenic rice plants might get introduced to enter into the human food chain. A country dealing with non-GM normal rice and high value basmati rice has to be capacitated to enable the identification and quantitative estimation of transgenic rice into traded varieties when transgenic rice enters into food chain. If the transgenic trait of GM rice is known, then it would be possible to

[81] IFAMA, http://www.ifama.org/files/20110137.pdf accessed on 23rd June 2016

quantity these in any lot by nucleic acid based tests. Specific transgenic traits will have to be identified and portions of transgenic nucleotide sequences emanating from either the transgenic promoter sequence part or the open reading frame part or the terminator part or any other transgenic part that would be unique to that transgenic trait can be modified by using suitable probes and applying PCR techniques. India can get itself empowered with such techniques once transgenic rice is approved or even field tested. The unique identity preservation by such nucleic acid test techniques shall enable the country to address various environmental as well as social issues connected with the use of transgenic varieties.

It can be summarized from the above that although GM trait in Basmati rice is not a trade issue yet because of non-existence of any GM rice varieties in commercial circulation, scientific methods exist which can be utilized to identify and authenticate GM traits in Basmati rice samples. Identification of GM traits can be carried out in diverse activities of stakeholders of rice production of different kinds, starting from seed suppliers to farmers, millers, traders, exporters and consumers. Identity Preservation including GM trait assessment would however cost and in each stage the stakeholders have to absorb the costs if such procedures become part of the trade. Obviously introduction of such procedures would result in increase in the cost of rice including Basmati rice and the consumers would have to bear such additional expenses. As Basmati rice is sold at premium prices, such costs of identity preservation may not affect the consumer prices as the additional cost of identity preservation by genetic methods would work out to be a very small percentage (less than 1%) of the cost of production of premium Basmati rice.

5.4 DISCUSSION AND REMARKS

The above description of the three examples of plant species examined namely soybean and rice including Basmati rice provide information based on which the following conclusions can be drawn:

1) Identity preservation by the existing methods of phenotypic observation carried out in the case of soybean and basmati rice are inadequate tools to track the purity of the traded commodity. The existing system is essentially running on trust and trade can be severely jeopardized in regions where there is great resistance to accept transgenic cultivars. Authenticated Identity Preservation infrastructure

requires procurement, documentation and testing of planting seeds at farmer's level; preparation and inspection of the fields initially and intermittently while the crop grows through established standard operating practices; maintain cleanliness of all equipment used for seed sowing, cultivation and harvesting; transferring harvested crops to the buyer silos in clean transporting system; and maintaining records at every stage which can be audited. Installation of such procedures would entail incurring substantial costs.

2) However, scientifically validated methods are available to carry out all steps of identity preservation and to track the quality of samples drawn from various supply points to not only detect but to also quantitatively to estimate the extent of transgenic traits in samples earmarked for evaluation. Such scientific methods are based on nucleic acid tests which are available in several formats and can be chosen for specific purposes by the regulatory authorities or by trade as would be required.

3) Nucleic acid based methods are available to identify the presence of GM trait in Soy samples. Therefore, regulatory authorities can be empowered with such techniques to identify and estimate such GM traits when required.

4) As regards GM trait in rice sample including basmati rice, it has been brought out that the GM traits can be identified and quantified when required. However, identity preservation methods requiring such traits seem to be not immediately relevant as GM rice is not yet ready for introduction in human food chain.

5) Genetic methods of identity preservation can be developed to identify specific varieties of non-GM soybean as well as non-GM basmati rice or any other non-GM rice. Therefore, on the basis of market needs identity preservation methods based on nucleic acid tests can be identified and included within the armory of regulatory and trade authorities to authenticate trade samples when required.

6) Genetic identification methods for non-GM Soy and Basmati varieties can be used as tools to develop and improve better cultivars.

CHAPTER 6

REQUIREMENT FOR IMPLEMENTING AN IP SYSTEM FOR LMOs

An IP system is designed to provide assurance that the desired qualities or traits are present (or absent) in a product starting from the seed source, through all steps of cultivation, processing and delivery to the end user. It also requires a set of actions to allow traceability and defined labelling requirements so as to communicate the presence or absence of a specific trait to the consumers.

Implementing an IP system requires that standards, records and auditing must be in place throughout the crop production and handling process and not just limited to testing of the end product. A common example of a successful IP programme is the production of certified seeds. Seed certification programmes have been implemented successfully in maintaining the integrity of crop varieties and thereby providing farmers with seeds of high purity and quality. Similar principles are used in development of IP programme for agricultural commodities or LMOs.

The elements of procurement strategy are imbibed in the wishes and desires of buyers where strategies adopted can be simple such as purchases based on graded and non-graded factors to complex requirements such as ensuring establishment and integration of a full system from sowing to grain production and grain handling. There are considerable amount of literatures describing the numerous steps and terminologies to establish and ensure product authentication and differentiation system[82,83,84,85].

Based on the review of various IP programmes in place for seeds and agriculture commodities, the key factors essential for implementing an IP system for LMOs are presented below:

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[82] Sonka S et. al, Transportation, Handling, and Logistical Implications of Bioengineered Grains and Oilseeds: A Prospective Analysis, United States Department of Agriculture, November 2000
, https://naldc.nal.usda.gov/download/38358/PDF

[83] Smyth S et. al, Product Differentiation Alternatives: Identity Preservation, Segregation, and Traceability, 2002, AgBioForum, 5(2): 30-42,
https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/306/Product%20differentiation%20alternatives.pdf?sequence=1&isAllowed=y

[84] Wilson WW et. al, Issues in Development and Adoption of Genetically Modified (GM) Wheats, AgBioForum, 2003, 6(3): 1-12,
https://pdfs.semanticscholar.org/54a1/65d598817027763d7864d7a8720bf85d3db1.pdf

[85] Bennet GS, Food Identity Preservation and Traceability, CRC Press, 2010,
http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_resursu_biologija/gramatas/Food%20Identity%20Preservation%20and%20Traceability.pdf

6.1 PROCUREMENT & PLANTING OF SEEDS

The planting seed material and its purity standards are the initial factors to ensure delivery of final grains/commodities of standard quality. The planting seed material must meet the prescribed international and national purity standards .Where feasible, the purity can also be authenticated by nucleic acid testing methods. Records of procurement, sources of planting seed material and records of genetic testing if carried out, have to be preserved.

6.2 AGRICULTURAL FIELD AND ITS SUITABILITY

The field used for planting should be eligible for maintaining IP standards. The field should not have been used during the previous year for growing other crops that could produce inseparable volunteer plants or contaminating weeds. Necessary cleaning practices are to be in place to ascertain proper preparation of the field. Records must be maintained by the farmers/owners using the field to document crop history.

6.3 FIELD ISOLATION

Another important aspect during the cultivation process is to ensure maintenance of appropriate isolation distances or other forms of reproductive isolation to prevent pollen flow and thereby setting of unwanted seeds. The isolation distance depends on several factors such as flower characteristics, sexual compatibility with neighbouring crops, pollen quantity and viability and mode of pollen dissemination etc. Self-pollinating crops require relatively small isolation distances, whereas cross pollinating crops may require maintenance of several kilometres isolation distance. Wind or insect pollinated crops require different kinds of isolation distances to be maintained.

Isolation distances used for GM crops are prescribed by regulatory agencies and are based on accepted distance for pure seed production. In India, the isolation distances to be followed for certified seeds have been prescribed under the Indian Minimal Seed Certification Standards by Department of Agriculture and Cooperation, Ministry of Agriculture. These standards are developed based on years of experimental data and have been accepted globally as standard methods for reproductive isolation by regulatory authorities. Even after maintaining appropriate reproductive isolation, the harvested crops have to be quantitatively assessed by appropriate testing methods to record the purity.

6.4 EQUIPMENT AND FACILITY

Starting from seed planting to maintenance of field, harvesting system including the equipment, the conveyors, the storing silos and the transporting vehicles need to be thoroughly cleaned before and after every operation, inspected and certified to be complied with so as to eliminate changes of contamination. Standard operating procedures need to be developed and practiced.

6.5 SAMPLING AND TESTING

Samples of the products have to be tested at various stages to confirm product and identification, purity and quality. An effective IP programme must have the procedures in place for statistically representative samples as well as reliable testing techniques. Appropriate statistical procedures are extremely important and must be applied to determine the number of samples required for generating a test result. Such sampling approaches for grain lots are prescribed by various agencies like International Seed Testing Association (ISTA), Grain Inspection, Packers and Stockyards Administration (GIPSA), International Organization for Standardization (ISO) etc.

In addition to using appropriate sampling procedures, sampling must be performed at key audit points within the product chain, focussing on where the custody of the product is change from one stakeholder to another. Common sampling points for testing are at the seed source for planting, the field prior to harvest, sale and storage facility, processor receipt and final product.

Regarding the testing of GM crops and products, there are several methods used to test for the absence and presence of inserted genes in seeds and final products. Each of these methods have specific advantages and disadvantages in terms of cost and efficacy and accordingly can be used at specific stages of the procurement and processing activities. Immunological techniques include lateral flow strips and enzyme linked immunosorbent assays (ELISA), which are based on antibodies to detect specific protein produced by the inserted transgenes. The lateral flow strips are simple and rapid, generally giving results in less than 10 minutes, whereas

ELISA assays require specialized treatment and take longer to perform. Depending on the proteins being assayed and the techniques are employed. More reliable methods are based on DNA based testing for the sequences that encode the transgenic trait rather than the protein being produced. The most common technique is polymerase chain reaction (PCR) based tests. PCR based assays are extremely sensitive and capable of detecting just a few molecule of the target DNA. In addition, newer methodologies are being developed including the use of microarrays for testing of GM crops. Applicability of suitable testing methods also takes into account the cost consideration during the IP programme.

6.6 RECORD MAINTENANCE AND LABELLING

It is extremely important to maintain records of all designated fields, harvested amounts, storage locations and product transfers. IP products must be identified segregated and labelled at all times in the production process. Labelling must be undertaken as per the requirements of the market in which it is to be sold and in compliance with the regulatory requirements of specific country.

6.7 AUDITING AT KEY STAGES OF PRODUCTION CHAIN

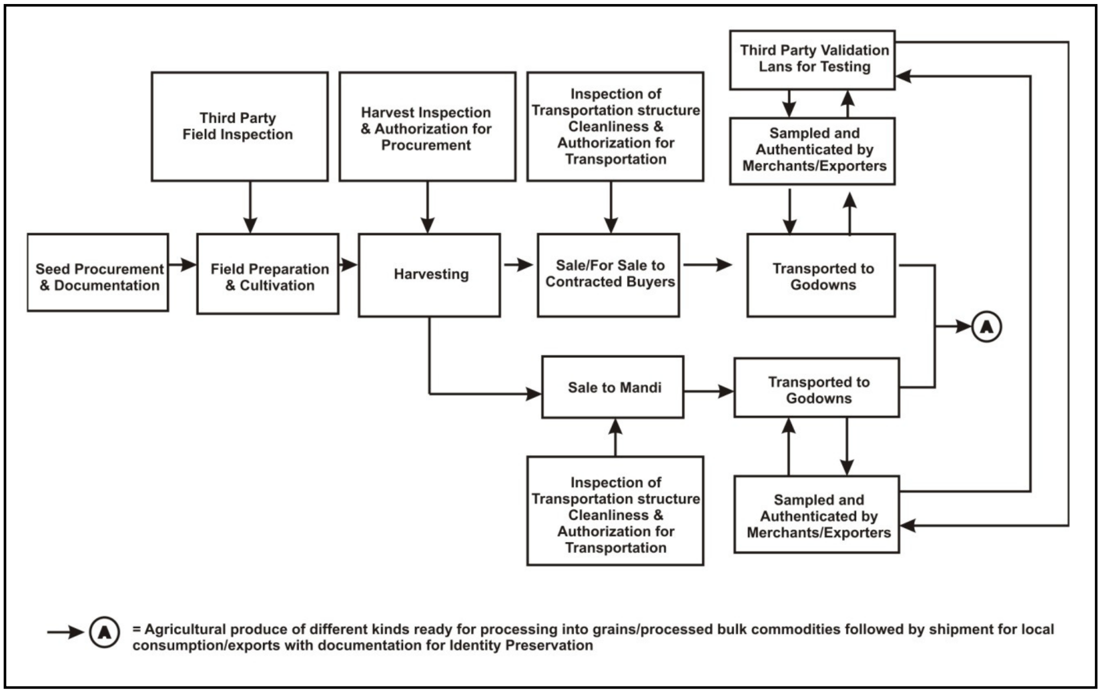
There are several important vulnerable points in the production chain which require vigilance and adoption of testing protocols to ensure delivery of IP preserved commodities. Its include

V**erification and Audit of:**

- Seed lots used for planting
- Field preparation inspection before and during crop grown and crop maturity
- On farm storage equipment cleanliness
- Cleanliness of transportation equipment and generation of documentation records
- Process's storage equipment cleanliness and certification.
- Testing of in process and finished lots at processors end
- Generation of documentation/receipts at processors end
- Generation of receipts for local market/overseas market by the supplier/seller
- Testing and generation of results at receivers end which is optional.

The stages where IP methods are important and critical requiring testing and documentation are depicted in **Figure 6.1**.

Figure 6.1: Stages where IP methods are relevant requiring testing and documentation



There are several service providers, who provide the audits of the supply chain and such agencies can also be engaged for providing third party services.

6.8 ECONOMIC ISSUES OF ESTABLISHMENT AND MAINTENANCE OF IP

Maintenance of the purity of standards of IP crops requires incurring more costs. The activities of maintaining IP standards in production, handling, processing, testing and documentation at each stage are associated with costs. There are several studies that have looked at the costs of IP and segregation for a large number of commodities at various stages of operations. The following **Table 6.1** adopted from a recent compilation[86] shows the extent of variation in the cost of segregation and establishment of IP system.

[86] Doshi KM et. al, Identity Preservation in Genetically Modified Crops, Recent Advances in Plant Biotechnology and its Applications, Chapter: Identity Preservation in Genetically Modified Crops, Publisher: I.K. International Pvt. Ltd., New Delhi, India, Editors: Ashwani Kumar and Sudhir K. Sopory, pp.229-256, https://www.researchgate.net/publication/236943862_Identity_Preservation_in_Genetically_Modefied_Crop

Table 6.1: Various Studies Estimating the Cost of Segregation/IP

Parameters analyzed/ Methodology/ Scope of Analysis	Estimated Cost of Segregation/IP (US cents/bushel of grain)
Econometric Model of Costs for Primary Elevators	Increase of 2 grades handled increased costs< 0.5 c/bu
Survey of Elevator Mgrs and Processors	11 to 15 c/bu
Cost Accounting Model for High Oil Soybeans	3.7 c/bu
Econometric Model of Costs for Terminal Elevators	Increasing grades handled increases operating costs by 2.6%
Stochastic Simulation Model	1.9 to 6.5 c/bu
Simulation Model for High Oil Corn	1.6 to 6.5 c/bu
Survey of Grain Handlers	6 c/bu corn, 18 c/bu soybeans
Cost Accounting	30 to 40 c/bu soybeans
Survey	25 to 50 c/bu
Survey of Elevator Mgrs, for Wheat	15 c/bu
Cost Accounting Adjustments to Survey Results for Specialty Grain Handlers	22 c/bu corn, 54 c/bu soybeans
Analysis of GM IP System for Canola in Canada, 1995-96	21-27 c/bu
Added Transportation and Segregation	15-42 c/bu High throughput
Costs for Dedicated GM Elevators	23-28 c/bu Wooden Elevators Non-GM Canola 38-45 c/bu Non-GM Soybeans 63-72 c/bu

It can be seen from the above information that the cost of establishing an efficient IP system can be considerable; from the data presented above, the cost incurred ranged from US $ 0.01 to 0.72 per bushel of grain produced. Some other studies carried out in Europe shows that the costs would be Euro 5 to Euro 25 per ton of grain; the wide range emanates from the grains considered for estimation and the IP system followed. Based on these data, it has been calculated that introduction of a rugged IP system would lead to increase in the prices of grains from 6% to 17% more on the existing farm-gate prices[87].

[87] Miraglia M et. al, Detection and traceability of genetically modified organisms in the food production chain, Food and Chemical Toxicology 42 (2004) 1157–1180, http://s3.amazonaws.com/academia.edu.documents/41177934/Detection_and_traceability_of_geneticall20160115-16228-f1ab3u.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1486544623&Signature=t27gFMMFoBqioXUx6jDzPBfqif4%3D&response-content-disposition=inline%3B%20filename%3DDetection_and_traceability_of_geneticall.pdf

Presently the world over, the IP system is established in the trade of GM seeds. In India too, the GM seeds are segregated and truthfully labelled in accordance with the Indian Seeds Certification Standards and Indian Seeds Act. However, after the seeds are traded, the entire value chain in production of handing of GM crops, there is no IP system rigorously maintained. GM crops are traded internationally with accompanying documents of "may contain" language and such documents are accepted the world,

For trade in non-GM crops however, there are precise limits of tolerance allowed and enumerated in the laws of certain countries. In India, for non-GM crops trade, no tolerance limits of GM contamination have yet been prescribed while a law has been enacted the labelling of packaged GM food. Non-GM product labelling is not however the subject matter of this report.

6.9 DISCUSSION AND REMARKS

Systems, Standard Operating Practices and Documentation can be adopted for establishing IP for GM crops. Managerial capacities exist and rugged scientific methods are in place to implement IP procedures. However, establishment and enforcement of IP would increase the cost of grain and therefore foods produced there from. The benefits of value-added crops can be captured if the buyers are ready to pay for the increased added costs. Since the main driving force for introducing GM crops and processed GM foods is to reduce the price and be benefited from the lower cost of production of GM crops, it is to be ascertained if the incurred incremental cost of establishing IP in such products would be affordable from within the incremental benefits of cost of production of such products. Further, there are strong societal issues for the acceptance of GM products in human food chain. The present world experience in certain countries indicate that GM labelled products have not been accepted by the consumers and stores have therefore withdrawn from stocking of such products in their establishment.

CHAPTER 7
PREPAREDNESS OF INDIAN AGRICULTURE FOR ADOPTING IP SYSTEMS

7.1 INTRODUCTION

While the sharp rise in food grain production in 1970s during India's Green Revolution enabled India to become self-sufficient in food grains, the tempo could not be held for long. Those periods of phenomenal increase in crop production especially for wheat and rice resulted in increased demand for rural labor thereby causing rise in the rural wages and effecting some reduction in rural poverty. But these input-intensive agricultural technologies requiring increased consumption of chemical fertilizers and water besides deployment of lesser number of seed varieties could not maintain its tempo of growth in 1990s, 2000s and thereafter. The growth slowed down during 1990s and 2000s to an increase of about 3.5% per annum for agriculture (as a whole) and 1.4% per annum for cereals[88].

It is estimated that roughly 600 million Indians are farmers including their families. The acceleration in the growth of non-agricultural sector following the 1991, transforming Indian economy into a market-oriented one **was accompanied** by a decline in the agriculture growth rate during the period 1994-95 to 2004-05. While the non-agricultural GDP growth rate exceeded 7% per annum, the agricultural GDP growth was at 1.7% (1993-94 base prices). During the same period, the annual growth rate of food grains in quantities was only 0.7% and all agricultural products together during the period had registered 0.6% annual growth[89].

In terms of contribution to GDP, Indian agricultural sector contributed to a share of 17% in 2013-14 and is the largest employer in India's economy[90]. According to Indian Labour Year Book 2011 and 2012[91], the total employment in Indian agriculture was 246 million workers in the year 2009-2010. This was the largest segment of workers in unorganized sector in India; the labor force was vulnerable to exploitation because of low level of literacy, low general awareness, social backwardness and poverty.

[88] India: Issues and Priorities for Agriculture, The World Bank, http://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities
[89] The Progress of "Reform" and the Retrogression of Agriculture, http://www.macroscan.org/anl/apr07/pdf/Agriculture.pdf
[90] Agriculture's share in GDP declines to 13.7% in 2012-13, Economic Times, http://articles.economictimes.indiatimes.com/2013-08-30/news/41618996_1_gdp-foodgrains-allied-sectors
[91] INDIAN LABOUR YEAR BOOK 2011 AND 2012, http://labourbureau.nic.in/ILYB_2011_2012.pdf

7.2 WHY AGRICULTURAL LABOR RATE IS LOW?

With such a huge population working in agriculture, the turnout contributing to about 17% of its GDP is obviously considered low. Further, when the agricultural labor rate is compared individually with other sectors, the income of the agricultural labor is lower; this is perhaps linked with the low agricultural productivities resulting from deployment of low grade technologies, lesser holding of farm land per households where the average farm-land holding is less than one hectare which limits their capabilities to taking risks of producing multiple crops. Most individual Indian farming households do not breakeven and get entangled into debt. Several government schemes are floated from time to time to funnel money to them periodically but such money has not resulted in any significant material improvement yet; government has been constrained to announce periodic waivers of farm loans which ultimately do not benefit the society at large.

7.3 WHO TAKES AWAY THE LION'S SHARE?

Indian agriculture on an overall basis has to contribute to improving the welfare of its rural poor. The challenges require developing more efficient agricultural technologies and inputs that contribute to raising productivity per unit of land use. The benefits from increased productivities should be accrued by the farmers. Usually when such benefits materialize, the lion's share is taken away by other actors such as the suppliers of more productive seeds, providers of efficient fertilizers & pesticides and suppliers of efficient machinery & appliances. Even for "higher value" crops grown by the farmers, the middleman and others down the line reap more benefits. Poor farmers have thus far very little to gain from the infrastructure developed in reducing the marketing costs of agricultural produce. In the present time therefore, the strategies that contribute to reducing rural poverty through innovative measures need to be developed and efficiently used. Only government interventions in the Indian context are an efficient way that could accrue hopes. Unfortunately, during the present time, it is more about promises from the government and less about efficient implementation of measures to uplift the individual rural income. Government has recently taken steps to address improvement of soil and efficient use of water to improve agricultural production. Organic farming schemes are encouraged. Improved access to irrigation through "Pradhanmantri Gram SinchaiYogana"[92], enhancing

[92] PMSKY, http://pmksy.gov.in/

efficient water use through "Per Drop More Crop"[5] policy and continued support to Mahatma Gandhi National Rural Employment Guarantee Act[93] and creation of agriculture market to boost farmers' income[94] are steps in the right direction[95]. These and many other schemes in the agriculture sector are expected to generate momentum for higher productivity. However, what is to be emphasized is the right way of implementing the schemes so that the benefits are accrued individually by the rural poor farmers and the benefits are fructified through increased income and wealth for the farmer families.

7.4 HOW IS AGRICULTURE PROFESSION VIEWED?

A survey[96] conducted during the period of December 2013 to January 2014 by Centre for the Study of Developing Societies (CSDS), Delhi (a private organization) brought out a discouraging future for Indian agriculture however. The survey was conducted on more than 5300 farmers across the country. Nearly 28% of the farmers surveyed expressed that they did not like being farmers anymore and they were continuing only because alternatives were not in place. Of the 72% who wish to continue as farmers, nearly 60% wished to remain as farmers as this was their traditional ancestral occupation. Only 10% opined that farming led to their good livelihood. More than 6% respondents opined that they would give up farming if better alternatives were available. Three Fourth of the farmers' children opined that they would leave farming when they grow up. The survey was echoing a dismal mindset trend of farmers which certainly was not an encouraging situation for the country.

7.5 AVERAGE YEARLY INCOME OF INDIAN SMALL FARMERS

Average yearly income of Indian farmers is reported to be Rs. 6426 per month or about Rs. 77112 per year[97]. Most of the farmers sell their produce to private traders and often did not sell to the government procurement agency or through state-run mandis. Sizeable portions of cereal crops such as rice and wheat grown by them are preserved for their own consumption and a part of the surplus is sold. A minority of the farmers however sell their cereals through government agencies and gets

[93] NREGA , http://www.nrega.nic.in/netnrega/home.aspx
[94] Mobile phone services can raise farmers' income, YourStory, https://yourstory.com/2015/05/vodafone-kisan-mitra/
[95] ENAM, http://www.enam.gov.in/NAM/home/about_nam.html
[96] Status of Indian farmers, Centre for the Study of Developing Societies (CSDS), Delhi, http://www.lokniti.org/pdf/Farmers_Report_Final.pdf
[97] Does it pay to be a farmer in India: The Hindu, http://www.thehindu.com/data/does-it-pay-to-be-a-farmer-in-india/article6713980.ece

Minimum Support Price. These ground conditions and realities result in income disparities. There is also income disparity generated from inter-regional variation of yields. The yield of wheat and rice from the states of Punjab, Haryana is higher than those from other states. Further, while sales of rice, wheat and certain other crops receive Minimum Support Prices and “input subsidy” for use of electricity, fertilizer and water, the farmers accrue more benefit when they are situated in the “irrigated region” (such as in North West India) than those farmers who are situated geographically elsewhere in “non-irrigated regions”. Government policies therefore require change to enable the rationalization of the income parities of farmers.

7.6 MAJOR CROP OUTPUTS OF INDIAN AGRICULTURE

Growing of agricultural crops including cereals, oil seeds, fruits and vegetables, fiber (cotton, jute, flex) etc. grown by marginal, small and medium farmers are driven more from subsistence point of view than from industrial-temper point of view. Although several multinational companies and large firms are in place who have adopted agriculture as a business and have introduced several measures from selection of seeds to cultivation followed by harvesting, processing and sale in order to ensure the quality of the finished products are uniform, stable and of defined higher quality, this is not the case for most of the agricultural outputs emanating from marginal, small and medium farmers. Such farmers are not yet adequately experienced in handling products of premium quality attributes. To expect that such farms would voluntarily comply with all the measures of SOPs and maintain records of their activities on each stage of farming starting from purchase/procurement of seeds to farming practices in the agricultural fields followed by harvesting and sale are tasks which are beyond their preview at the present moment. Moreover, when the earning per unit of land use is low and when the average land holding per farmer family is also low, these farmers are not in a position to handle such situations which would require incurring of additional costs to their produce.

The production of major crops[98] in India during the last 5 years from 2008-09 to 2012-13 was as in **Table 7.1**:

[98] PIB, GOI, 16th May 2014, http://pib.nic.in/newsite/erelease.aspx?relid=105083

Table 7.1: Quantum of major crops produced in India

Crop	2008-09	2009-10	2010-11	2011-12	2012-13
FOOD GRAINS (million tonnes)					
Rice	99.18	89.09	95.98	105.31	105.24
Wheat	80.68	80.80	86.87	94.88	93.51
Jowar	7.25	6.70	7.00	6.01	5.28
Bajra	8.89	6.51	10.37	10.28	8.74
Maize	19.73	16.72	21.73	21.76	22.26
Coarse Cereals	40.04	33.55	43.40	42.04	40.04
Tur	2.27	2.46	2.86	2.65	3.02
Gram	7.06	7.48	8.22	7.70	8.83
Urad	1.17	1.24	1.76	1.77	1.90
Moong	1.03	0.69	1.80	1.63	1.19
Total Pulses	14.57	14.66	18.24	17.09	18.34
Total Food grains	**234.47**	**218.11**	**244.49**	**259.32**	**257.13**
OILSEEDS (million tonnes)					
Groundnut	7.17	5.43	8.26	6.96	4.69
Rapeseed & Mustard	7.20	6.61	8.18	6.60	8.03
Soybean	9.91	9.96	12.74	12.21	14.66
Total Nine Oilseeds	**27.72**	**24.88**	**32.48**	**29.80**	**30.94**
FIBRE (million tonnes)					
Cotton #	22.28	24.02	33.00	35.20	34.22
Jute, Mesta # #	10.37	11.82	10.62	11.40	10.93
SUGAR PRODUCING CROPS (million tonnes)					
Sugarcane	285.03	292.30	342.38	361.04	341.20

Food grain production during 2014-15 was as estimated to be 251.12 million tones whereas those during the previous year (2013-14) were 265.04 million metric tonnes[99]. These figures provide a flavor of the quantum of production of food grains in India as also of some of the selected agricultural crops.

[99] Foodgrain production during 2014-15 crop year declines by 13.92 MT, Times of India, 13 May 2015,

7.7 OPERATIONAL LAND HOLDING SCENARIO

Indian agricultural output is primarily from marginal, small and medium holders of farmland. The percentage of operational holdings along with categories of holdings from 1970-71 to 2002-2003 can be seen in **Table 7.2** below[100].

Table 7.2: Changes in land size distribution of operational holdings

Category of holdings*		**Percentage of Operational Holdings**			
Year→→→→	**1970-71**	**1981-82**	**1991-92**	**2002-03**	
Crop Season	**All Season**	**All Season**	**All Season**	**Kharif**	**Rabi**
Marginal Holdings	45.8	56.0	62.8	69.7	70.0
Small Holdings	22.4	19.3	17.8	16.3	15.9
Semi-Medium Holdings	17.7	14.2	12.0	9.0	8.9
Medium Holdings	11.1	8.6	6.1	4.2	4.4
Large Holdings	3.1	1.9	1.3	0.8	0.8
All Sizes	**100**	**100**	**100**	**100**	**100**

***Marginal holdings= less than 1 hectare, small holdings= 1-2 hectares, semi-medium holdings=More than 2 up to 4 hectares, Medium holdings=More than 4 up to 10 hectares, Large holdings= Above 10 hectares.**

It can be seen from the above table that operational holdings have declined progressively over the years with each decade. The percentage of large, medium and semi-medium holdings has also been declining steadily. Interestingly, crowding of holdings has been into the marginal category.

http://timesofindia.indiatimes.com/business/india-business/Foodgrain-production-during-2014-15-crop-year-declines-by-13-92-MT/articleshow/47268453.cms

[100] Some Aspects of Operational Land Holdings in India, 2002-03, http://mail.mospi.gov.in/index.php/catalog/35/download/438

7.8 CONTRIBUTION OF FARMERS OF VARIOUS CATEGORIES IN INDIAN AGRICULTURE

Another interesting fact revealed is that the contribution of marginal, small and medium farmers to the production of major crops like rice, wheat and sugarcane in India has been maximum[101] as can be seen from the data of three decades starting from 1981 to 2001 in **Table 7.3** below, which trend continues.

Table 7.3: Production of various major crops by marginal, small, medium and large holdings

Names of the Crops	Category of Holding	1981	1991	2001
		% of the Total Production for the Year		
Rice	Marginal	22	26	32
	Small	21	23	20
	Sub Total<2ha	**43**	**49**	**52**
	Medium	25	25	24
	Large	32	26	25
Wheat	Marginal	16	20	24
	Small	15	19	19
	Sub Total<2ha	**31**	**39**	**43**
	Medium	23	23	23
	Large	46	38	34
Pulses	Marginal	11	13	14
	Small	13	16	20
	Sub Total<2ha	**24**	**29**	**34**
	Medium	20	23	25
	Large	56	49	41
Sugarcane	Marginal	16	23	23
	Small	19	23	26
	Sub Total<2ha	**35**	**46**	**49**
	Medium	27	26	27
	Large	38	28	25
Oilseeds	Marginal	10	11	13
	Small	13	16	20
	Sub Total<2ha	**23**	**27**	**33**
	Medium	22	24	26
	Large	55	49	41

Note: Figures for 1991 & 2001 computed from data in Agricultural Census & Agricultural Statistics at a Glance. Figures for 1981 for Small Holder in India: Food Security and Agricultural Policy, 2002, FAO Publication, Figures are comparable. Marginal =< 1 hectare (ha), Small=1-2 ha, Medium=2-4 ha, Large=> 4 ha. ha=Hectare

Marginal and small farmers are not quite organized and have several problems to face while continuing their livelihood as practitioners of agriculture. Large farms on

[101] Mehrotra N, Emerging Patterns in Share of Small Farms in Production and Credit, http://www.igidr.ac.in/conf/money/mfc-12/Emerging%20Patterns%20in%20Share%20of%20Small%20Farms%20in%20Production%20and%20Credit_%20Implications%20for%20Policy%20Formulation.pdf

the other hand are more organized and can resort to introducing modern agricultural practices to make agriculture activities on a business model.

Marginal, small and medium farmers would however continue to contribute their might by producing a wide range of crops, cereals, pulses, oilseeds, fruits & vegetables, fibers and many others to keep Indian agricultural production high.

7.9 RELEVANCE OF IP AND VALUE CHAIN

Identity Preservation (IP) in agriculture which is essentially a trade issue to fetch premium prices for traded commodities is therefore a phenomenon not quite relevant and appropriate for marginal, small and even medium farmers. IP would become relevant to these actors when organized sector actors chip in and enroll these farmers for supply of premium products through training and allied support. In the meantime, Indian agriculture must be modernized on par with industrialized countries to enable introduction of such attributes as IP, as in such instances agriculture would really become a globally competitive business like other valued added contributors to Indian economy such as industry and service sectors.

In addition to creating awareness and provide modern facilities to farmers, the other stakeholders in value chain also need to be trained and systems put in place for implementing an effective IP system for LMOs in Indian agricultural scenario. These would include small traders in mandis, transporters, processors etc. The legal requirements for labeling, particularly for LMOs have to prescribed by Food Safety and Standards Authority of India including the type of label, specification of ingredients, threshold value etc.

7.10 IMPACT OF Bt COTTON TECHNOLOGY AMONG POOR FARMERS

Bt Cotton technology was adopted for use in India in March 2002. Following approval and adoption by the farmers, they started benefitting from reduction in chemical pesticide use, higher effective yields of cotton lint and significantly higher profits. By 2007, 65% of the country’s cotton area was planted with Bt Cotton, which increased to 90% of the total cotton area in 2014 covering 11.60 million hectares. Use of Bt Cotton seeds in cultivation resulted in increase in farmer’s income by 83% over non-Bt cotton. Further, Bt Cotton cultivation generated more labor employment than non-Bt Cotton with female labors becoming major beneficiaries among the casual workers who were hired in preference to male workers, for both planting and cotton picking. Several studies showed that adoption of Bt Cotton technology resulted in increased yield between 30-40% and reduced insecticide quantities by about 50% on an average, thus generating substantial additional income estimated at US$ 156 per hectare or more. Income gains among poor farmers were manifested in demand for more food and non-food items; the extremely poor as well as the moderately poor farmers were substantially gainfully benefitted[102,103,104]. Bt Cotton seeds traded were identity preserved and labeled in accordance with the relevant statutes. Lessons learnt from the use of Bt Cotton technology revealed that farmers of different social status including the rich and the poor are eager to induct GM technologies if these economically benefit them. Farmers procure identity preserved Bt seeds to ensure fructifying the benefits from cultivation of cotton. However, down the value chain of Bt production, there was no segregation or identity preservation procedure in place such as in the activities of manufacture and trading of cotton seed oil or cotton seed mill carried out by the processors and traders, presumably because there was no added value or economic advantage in doing so, nor there was any societal pressure in place.

7.11 DISCUSSION & REMARKS

Indian agricultural output is essentially from marginal, small and medium land holders. The profession is leaned more towards subsistence than towards business. While Indian annual production of crops, oilseeds, fiber and sugarcane has been impressive making the country essentially self-reliant, the trend is yet not towards production of more value-added crops. The profession is yet to emerge as a business model on the wider canvas like other economic sectors although a small number of organized actors have chipped in to handle premium products to fetch increased margins. While the experience of such organized actors enables India to move form strength to strength while dealing with specific crops such as basmati rice, premium quality wheat, onion, potatoes, spices, tea, coffee, certain fruits & vegetables, such a situation cannot be imbibed upon and generalized for all cereals, pulses and oilseeds especially taking into consideration the present scenarios of economic conditions of management of small and even medium farmers. Introduction

[102] Sadashivappa P et. al, Bt Cotton in India: Development of Benefits and the Role of Government Seed Price Interventions, AgBioForum, 2009, 12(2): 172-183, AgBioForum, http://www.agbioforum.org/v12n2/v12n2a03-sadashivappa.pdf
[103] Choudhary B et. al, Bt Cotton in India: A Country Profile, ISAAA Series of Biotech Crop Profiles, July 2010, https://www.isaaa.org/resources/publications/biotech_crop_profiles/bt_cotton_in_india-a_country_profile/download/Bt_Cotton_in_India-A_Country_Profile.pdf
[104] Pray CE et. al, Impact of Bt Cotton, the Potential Future Benefits from Biotechnology in China and India, https://pdfs.semanticscholar.org/719c/0b34fc478af0d65aea0305071cefbd6ed2e0.pdf

of value added traits such as IP requiring the implementation of SOPs, Records keeping etc. can be intensified with more experience, specially keeping in mind the needs and requirements of uplifting the economic and social conditions of the marginal and small farmers.

CHAPTER 8
IP PRACTICES OF LMOs, VIS-À-VIS INDIAN FARMERS

8.1 INTRODUCTION

In Chapter 6, Table 6.1, information collected from literature on estimating the additional cost of segregation and IP was incorporated in a summarized form wherefrom it was found that such additional costs in Europe could be Euro 5 to Euro 25 per ton of grain and that this variation was on account of various factors such as the nature and the type of the grains, the yields obtained, the processing complexities to be followed as also the costs of the different validated methods for assessing the identity of different crops. These data when presented as % of the "existing" farm-gate prices of non-GM grains worked out to 6 to 17% more.

In Indian context, while studying the two agricultural commodities such as Soybean and Basmati, it was observed that the Indian exporters (of these two commodities) were able to absorb the additional cost of certification requiring to document after sampling and analysis, on and about the absence of GMOs in the exported consignments. In case of Soybean, for example, one company visited in Indore, which was engaged in the manufacture of non-transgenic food-grade Soy flakes for export to Japan mentioned that the export price received by the company from the importer from Japan was adequately high to absorb the costs incurred for generating a scientifically validated certificate from recognized Indian laboratories that the consignment did not contain any GMO. The Soybean Processors Association of India (SOPA) had also provided information that indicated that wherever required, samples of Soybean as well as processed materials produced there from are subjected to testing to ascertain the status of GM content in the consignments (vide Page 50-51 of the Report).

In case of export of basmati rice, another one leading Indian company visited mentioned that the foreign buyers especially from Europe demand non-GM certificates and the company complies with such demands by scientifically sampling the export consignments and getting those tested from NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited laboratories. They also mentioned that the additional costs for generating such certificates was small (less than 1%) when compared with export prices the company received.

While from these limited data, it could be concluded that large exporters were presently getting adequately compensated in prices for the produce from soybean and basmati rice exports, there was yet no information in the literature about the additional costs that are likely to be incurred either by the Indian farmers or by the Indian traders/merchants when IP system and methods, for LMOs were legislated in the country. Questions such as whether legislating IP system for LMOs would affect Indian farmers' livelihood or whether implementing such a system would lead to acceptance or rejection of LMOs in India could not be directly answered. However, in view of the brisk approval of LMOs globally and also having regard to the intensive research for developing genetically modified plants in India (page 8-11 of the Report), there are likelihood of such substances getting approved for commercial cultivation/use in India in near future. In the meantime, India had approved the commercial cultivation and use of Bt Cotton since March 2002 although the IP system is not yet practiced while trading in Bt Cotton. The GM seeds of Bt Cotton truthfully labeled in accordance with the provisions of the relevant Seeds Act, which practices are voluntary for the seller of seeds. Further, the products of Bt Cotton namely the cotton lint, the cotton seed oil, the de-linted cotton seeds as also the cotton seeds cake (after oil extraction) are traded without any labeling. In the meantime, Indian government has legislated a labeling law in August 2006 requiring "genetically engineered or modified food" to be labeled and this law is effective from 1st January 2013 (Page 14 of the report). However, cotton seed oil obtained from Bt Cotton seeds and sold in the trade are not labeled yet as GM.

8.2 SOCIO-ECONOMIC ISSUES LINKED WITH FARMER'S LIVELIHOOD

The Cartagena Protocol on Biosafety (CPB) in its Article 26 requires Parties to take into account socio-economic consideration while making decisions on imports of LMOs. The CPB also has an article on liability and redress (Article 27) which enable Parties to add up processes with respect to appropriate international rules and procedures in the field of liability and redress for damage resulting from transboundary movement of LMOs within a period of 4 years. In pursuance of this article of CPB, Parties negotiated for a new treaty known as the Nagoya-Kuala-Lumpur Supplementary Protocol on Liability and Redress which was adopted on 15th October, 2010. The key features of this treaty are on adopting, administrative procedures and requirement in the event of damage caused by LMOs. The damage is defined as adverse effect on the conservation and sustainable use of biological diversity that is measurable and significant. The damage does not include issues relating to pricing or such other factor that could affect farmers' livelihood. The socio-economic issues affecting farmers' livelihood emanating from the use of LMOs will therefore have to be dealt with by Parties on the basis of local laws and statutes. Further, (a) the supplementary protocol is yet to be adopted, (b) the reference to "damage" under supplementary protocol has only an indirect linkage to social-economic considerations and (c) after adoption, India has to formalize the legal requirements in the context of how to assess damage, who is an operator, modalities for redress and compensation etc. In Indian context therefore, what is more relevant is that Government of India has enabling powers to modulate and rationalize the use of LMOs to tackle socio-economic issues affecting farmers' livelihood through control of prices of LMOs at various stages of their use. Such enabling powers would however have to be judiciously exercised keeping in view India's commitment to TRIPS agreement, intellectual property protection, Citizen's rights and privileges etc. Further, Indian domestic laws regarding compensation under Seeds Act for crop loss may have to be modulated and rationalized to take care of the socio-economic issues linked with farmers' livelihood.

8.3 CONFLICTING INTEREST IN THE CONTEXT OF IP PRACTICES

In India, the issues of additional costs of producing/handling LMOs by all kinds of farmers impacting their livelihood as also the consumers' behavior to LMOs in the context of exercising their freedom of "right to choose" are factors which create conflict of interest among the various actors using LMOs. In order to understand these and connected issues, it requires to be analyzed why IP systems and practices were introduced for trading agricultural commodities. IP refers to systems and practices of tackling the details of the target agricultural commodities, the identity of unique characteristics of which are systematically preserved through records and practices. Practices of IP started in agriculture for commercial gain. IP preserved agricultural commodities are segregated during storage, handling and shipping procedures. With the introduction of LMOs, IP has taken another dimension in societies in the context of "right to choose". The main requirements for implementation of systems and practices of IP start with procurement, authentication through documentation and planting of LMO seeds. Agricultural fields where LMOs are cultivate require identification and certification for suitability on important issues such as earlier usage, possibilities of volunteers growing, issues related to maintenance of isolation distances of the cultivating fields both from the interest of the cultivator as also from the interest of the neighboring farmers, issues relating to maintenance and validation of equipment and facilities while handling the LMO crops, record maintenance and labeling, auditing at key stages of production chain and finally sampling and testing requirements including use of DNA testing methods. All these requirements have strong ingredients of economic issues both in establishment and maintenance of IP. India has capabilities in managerial practices, technical expertise, scientific knowledge and infrastructure as also a strong political stability to implement IP procedures. However, as the issue is intimately linked with economic benefits which are likely to shrink at various levels and as Indian agriculture is primarily in the hands of small and marginal farmers, and further as Indian farmers are generally poor, the issue of deciding on legislating IP would have to take into consideration the above facts. It is to be examined how much weight age needs to be given to issue of "right to choose" in this context.

8.4 INDIAN AGRICULTURAL SCENARIO IN THE CONTEXT OF LMOs & IP

Indian agricultural condition for certain major crops produced in the country and the cultivators/farmers producing these are further discussed below in the context of introducing LMOs and instituting IP practices. Information provided is based on published literature available on the internet. Rice, wheat, pulses, sugarcane and oilseeds form the major Indian agricultural crops. Among the cultivated fibers, cotton is the largest agriculturally growing fiber crop. India is also engaged in the development of several genetically modified plants and among these, R&D is also brisk in **cotton**, **mustard, rice and wheat** besides other crops and a large number of vegetables for the development of LMOs. Information was gathered on the status of economic returns presently being earned by the Indian small and medium farmers while cultivating the non-genetically modified versions of these crops so as to make an intelligent guess on how their earnings are anticipated to be raised/affected when the GM versions of these crops are introduced. Since Bt Cotton has already been introduced in Indian agriculture and since this has made sizeable economic impact on the lives of the poor Indian farmers, the implication of future introduction of IP practices in cotton cultivation has been discussed first.

Bt-Cotton

Cotton is an important cash crop in the agrarian economy of India. Cotton is extensively grown in nine cotton growing states of the country namely Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Karnataka, Punjab and Haryana. Lepidopteron pest resistant Bt Cotton technology, developed by Monsanto. USA and brought in India through collaboration by Maharashtra Hybrid Seeds Company Ltd, Jalna, Maharashtra was approved for production in India in March 2002 and by 2014 a record 11.6 million hectares of Bt-cotton area representing 95% of the total cotton area (12.15 million hectares) in India was created where Bt—cotton was planted. The cotton production increased from 13 million bales in 2002 to about 40 million bales in 2014 which production was about one quarter of the global total production estimated at 151 million bales (in 2014). Presently, Indian production of cotton is perhaps the largest in the world. It has been estimated that in 2014, 7.7 million numbers of small Indian farmer families having average holding of less than 1.5 hectares benefited from the planting of Bt Cotton. It has further been estimated that during the 13 year period from 2002 to 2014, some 54 million small holder cotton farmers of India continued to plant Bt Cotton over the years and the crop provided considerable economic benefits to the small holder cotton farming communities besides other categories of farmers[105]. In a survey study covering 1431 farm households selected in India and covering a period between 2002 and 2008, researchers from Georg-August-University of Goettingen, Germany concluded that by adopting Bt cotton technology the calorie consumption and dietary quality substantially improved in the families of poor cotton growing farmers because of increased family income. The study concluded that adoption of Bt Cotton technology reduced food insecurity by about 20% among cotton producing households[106]. It was also observed that Bt cotton technology was scale neutral and that the technology was adopted with ease by small land holders; farmers belonging to lower strata including OBCs and SC/ST category extensively used this technology. The technology provided employment to male farmers as well as the female farmers and the children in various facets of labor-inputs including ploughing, weeding, picking and cleaning operations. All these traits of the technology contributed to the creation of rural happy families with social satisfaction. Presently, the total cost incurred per hectare of land for cultivating Bt cotton is estimated to be around Rs. 35000, of which 64% is on account of labor, 17% is for the cost of fertilizers and irrigation, 12% is on account of purchase of Bt cotton seeds and 7% on an average is on cost of pesticides. The pesticide cost got substantially reduced from what was being consumed earlier. The farmers could pay the cost of the Bt cotton seeds happily and yet could earn more[107]. In India Bt cotton has been introduced as hybrids although both hybrids and open pollinate varieties (OPVs) exist in the country. Several cultivators transformed some of the OPVs in to hybrids through the adoption of Bt traits by repeated back crossing technology. Interestingly, on the basis of some agitation in certain parts of the country "public" demands were made seeking for lowering the prices of Bt cotton seeds when the prevailing market price per packet was Rs. 1200-1600/-. Government intervened in 2006 on the pricing of Bt Cotton seeds and fixed the prices per packet at Rs. 750/-. A packet of Bt cotton seeds was sufficient for planting one acre of land. This price was much lower than the prices the farmers had willingness to pay (WTP). WIP is the maximum price at or below which farmers would buy a packet of the product. Most farmers of all states were paying the prevailing market prices for Bt Cotton seeds at the market prices existing at that

[105] Choudhary, B. and Gaur, K. 2015. Biotech Cotton in India, 2002 to 2014. ISAAA Series of Biotech Crop Profiles. ISAAA: Ithaca, NY, https://www.isaaa.org/resources/publications/biotech_crop_profiles/bt_cotton_in_india-a_country_profile/download/Bt_Cotton_in_India-2002-2014.pdf

[106] Qaim M et. al, Genetically Modified Crops and Food Security, PLOS ONE, 2013, 8(6): e64879. doi: 10.1371/journal.pone.0064879, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0064879

[107] Mayee CD et. al, Adoption and Uptake Pathways of Biotech Cotton among Farmers in Selected Cotton Growing Villages of Maharashtra, Andhra Pradesh and Punjab in India, Indian Society for Cotton Improvement, 2013, http://www.cicr.org.in/isci/5-2/Paper_5.pdf

time. The decision of the government provided more benefits to the consumers of Bt cotton seeds. The decision had also contributed to reduction in the availability of 'spurious' packets of Bt-cotton seeds which were available in several parts of the country.

The decision of the Government created several other issues which were not favorable for the country. These included the decision of Monsanto to not to bring any other new seed technology to the country, the general dissatisfaction of the other research-based seed companies as a strong disincentive to reap as much benefits as the market could bear for their innovative products, retardation in further research, less interest among young people to develop careers in agriculture-based modern biotechnology etc.

As technology is the corner stone for generating more all-round benefits, all interventions require careful balancing of all the factors to bring in all-round net benefits to the country. In the context of introducing IP practices also, to keep up the interests of all the actors, the net profitability of the farmers need to be kept reasonably high in order to enthuse them to get encouraged in implementing IP practices so as to comply with the SOPs, bearing the additional costs of identification through cooperative procedures of cost sharing and to comply with the documentation processes so as to enable the authentication of the final LMOs. Increased monetary return should also be a built-in trait for encouraging implementation of IP practices. However, taking into consideration the factors that played in influencing the imposition of government intervention in fixing the prices of Bt cotton seeds, it appears unlikely that even in case of cotton it would be possible to implement IP and labeling in Bt cotton and the products derived there from where transgenic traits can be scientifically detected. The need for labeling the refined Bt cotton seed oil as is required under the existing Indian law is also untenable as no transgenic traits can be detected there in. The existing Indian labeling law therefore requires amendments delinking 'labeling' of such products as of GM origin.

GM Mustard

Recent news in published media focused on GM Mustard developed by University of Delhi scientists and these products have been thought to be getting released sooner in India [108,109]. The product designated as DMH-11 (Dhara Mustard Hybrid-11) has transgenic constructs contain the genes *bar, barster and barnase and* all are driven by *CaMV35S*

[108] Jayaraman KS, GM mustard inches towards release in India, NatureIndia, doi:10.1038/nindia.2016.116 Published online 9 September 2016, http://www.natureasia.com/en/nindia/article/10.1038/nindia.2016.116

[109] Jacob J ,GM mustard moves closer to approval , The Hindu, October, 1, 2016, http://www.thehindu.com/news/national/GM-mustard-moves-closer-to-approval/article14589131.ece

promoter. The hybrid DMH-11 codes for the above genes in different plant parts. Measurement of expression levels of the transgenic proteins in leaf, stem, roots, whole buds, seeds and seedlings showed low levels of expression. A report was published in "The Hindu" that a Technical Body assessed GM Mustard and found it to be safe for human and animal health and also opined that introduction of GM Mustard would not threaten biodiversity [110]. The developers of Hybrid DMH-11 Mustard claim a yield increase of 25-30% over non-hybrids[111,112]. However, this claim has been refuted by several NGOs[113].

Assuming that use of Hybrid DMH-11 Mustard would lead to yield increase by 25-30% over the existing non-GM hybrids, while such an increase will immensely benefit the Indian agriculture, the yield increase does not seem to be high enough to promote the introduction of IP and labeling requirements at all levels, especially at the levels of small and medium farmers as the consequence of introduction of such a system would considerably deplete the price preference that are expected, resulting from the increased yield. The increased yield will no doubt bring in considerable agronomic advantage to the mustard growers in the country but it seems inadequate to support the small and medium farmers on the introduction of IP and labeling practices. It requires to be ascertained however if the incremental increase in yield would enthuse the traders and processors of such mustard crop to bear the additional costs themselves so as to reap the additional economic benefits therefrom. There is yet no public voice raised by rich traders and merchants dealing with mustard and mustard oil on this issue.

In the case of Bt Cotton, it was observed that the technology enabled over 85% production increase in cotton lint over a period from 2001-02 (Bt Cotton technology was introduced in March 2002) to 2013-14; in figures, the cotton yield in 2001-02 was 308 kg/ha which increased to 570 kg/ha in 2013-14)[105]. The increased yield was mainly on account of reduction in the damage of cotton bolls by the lepidopteran pests and incorporation of Bt traits in efficient Indian cotton lines. Yet in case of Bt Cotton, stringent procedures of maintaining refugia around Bt Cotton fields could not be adequately implemented at farmers' level. While technology providers of Bt Cotton seeds were initially charging the prices of Rs. 1200-1600 per packet (sufficient for planting one acre) yet most farmers were willing to pay the high prices because even after paying such prices, their returns were more than what

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[110] Koshy J, GM mustard is 'safe', says technical body, The Hindu dated 5th October 2016, http://www.thehindu.com/sci-tech/agriculture/GM-mustard-is-safe-says-technical-body/article14624827.ece

[111] Briefing Paper on Delhi University's GM Mustard , DELHI UNIVERSITY'S GENETICALLY MODIFIED (GM) MUSTARD, 2015, h`ttp://indiagminfo.org/wp-content/uploads/2015/06/DU-GM-MUSTARD-BRIEFING-PAPER-coalition-final-jul10-2015.pdf

[112] Pental D, Deepak Pental Shreds Vandana Shiva's Rant Against GM Mustard, Smart Indian Agriculture, 2015, http://www.smartindianagriculture.in/deepak-pental-shreds-vandana-shivas-charges-against-gm-mustard/

[113] The Hindu Bureau, GM mustard won't raise yields, says anti-GM coalition, The Hindu Business Line, June 18, 2015, http://www.thehindubusinessline.com/economy/agri-business/gm-mustard-wont-raise-yields-says-antigm-coalition/article7329982.ece

used to be earlier by planting non-Bt Cotton, and the farmers (especially the small and marginal ones),accepted the prices. However, since there was adequate margin in such high prices charged by the technology suppliers, the system imbibed introduction of spurious Bt Cotton seeds in the market at lower prices. When government intervened to reduce the prices per packet of planting Bt Cotton seeds to Rs. 750 per packet, this promoted withdrawal of black marketers considerably, In other words, the market forces played their roles in modulating the advancement of Bt Cotton technology. The regulatory orders did not work in most critical areas.

GM Rice and GM Wheat

Worldwide experimentations are being carried out to develop efficient rice transgenic lines incorporating a wide range of traits such as insect, viral and herbicide resistance, abiotic stress tolerance, growth and development improvement to modify plant architecture as well as to produce more nutritious rice[114,115]. In case of wheat, the research on transgenic plant development is not as much intense as it is in case of rice. In Indian context, weedicide resistant transgenic wheat is being experimented upon utilizing inserted *psbA gene* in one Indian agricultural university. Several Indian institutes and private companies are engaged in the development of a wide range of transgenic rice which include Central Agriculture Research Institute, Directorate of Rice Research, International Centre for Genetic Engineering and Biotechnology, Jawaharlal Nehru University, Madurai Kamraj University, M.S. University of Baroda, Punjab Agricultural University, Tamil Nadu Agricultural University (CPMB), University of Agricultural Sciences, Bangalore, University of Delhi, Avesthagen private ltd., Maharashtra Hybrid Seeds Company Limited (Mahyco), Indian Agricultural Research Institute, National Research Centre on Plant Biotechnology. In case of wheat, G. B. Pant University of Agriculture and Technology is in the process of developing transgenic wheat with the weedicide resistant trait. In addition to rice and wheat, a large number of other crops, vegetables, fibre producing crops, oilseeds, pulses, sugarcane, tea and coffee are being worked upon; the investigations are yet in the R&D stage[116].

None of the above work in the development of transgenic plant varieties has yet reached the stage of commercialization. In case of rice and wheat, if the transgenic plant development leads to substantial increase in the value of the developed LMOs and if such products fetch higher prices which the consumers are willing to pay, then only the possibilities of

[114] Kathuria H et. al, Advances in Transgenic Rice Biotechnology, Critical Reviews in Plant Sciences, 2007, 26:2, 65-103, http://www.tandfonline.com/doi/abs/10.1080/07352680701252809#.VIL9RNIrJpQ

[115] Shabir, et al., Adv Genet Eng 2015, 4:3, http://dx.doi.org/10.4172/2169-0111.1000133, https://www.omicsgroup.org/journals/transgenic-rice-advancements-and-achievements-2169-0111-1000133.pdf

[116] IGMORIS website at: http://igmoris.nic.in/. Under IGMORIS, within "Groups of GMOs" sub-heading and further under "Transgenic Crops" sub-heading, all the data can be viewed

introduction of IP and labeling procedures can be implementable. The future developmental situation in these products on the ‘value addition” aspects need to be kept a close watch.

It is mentioned in this context that the developmental work in crop varieties through transgenic approach is unlikely to provide adequate surplus to enthuse the small and medium farmers to adhere to IP practices as these practices would require to incur additional costs, thereby pushing the cost of production higher. Transgenic crops of more nutritious value such as “golden rice” is essentially aimed at providing increased amount of Vitamin A precursors as also other nutritionally important elements such as iron, zinc etc. and therefore might fetch some increase in the selling price. However, such nutritional benefits can be derived by the rich consumers by other means and therefore the willingness of “rich customers” to pay for increased price may not be very high. The existing scenario of rice and wheat availability and distribution among the small and medium farmers of the country provides a glimpse that these classes of people are inclined to depend on welfare schemes and subsidies to obtain and fulfill their needs. In such a scenario, it is unlikely that it would be possible to keep the prices of these products very high in Indian context.

8.5 DISCUSSION

During the recent past, there has been alarming increase in the prices of most agricultural produce, notably edible oils and pulses besides rice (paddy) and wheat. Government tries to bring in solutions for stabilizing demand-supply imbalances through enactment of rational prices in order to keep both the producers (farmers) and consumers satisfied although the task is very complex and difficult. The in-country research base is yet at low level of accomplishment and therefore for tackling demand-supply imbalances, often the country has to look for foreign sources. Whenever effective foreign technologies become available, it requires the country to pay for it in huge prices. Under these circumstances, the Indian Agricultural Price Policy (IAPP) which aims to ensure on one hand remunerative pieces for agricultural commodities to assist the farmers to have increased income, on the other hand the IAPP has to safeguard the interest of consumers by ensuring to making supplies available at “reasonable” prices. In the process while Government fixes the minimum support price (MSP) for a wide a range of agricultural commodities, this does not often help the poor Indian farmers who therefore divert sizeable portions of their goods to sell their produce in the open market to derive more advantage to them. In such a prevailing ground scenario, it can be reasonably concluded that the Indian farmer who comprise mainly the poor people, would not like to share any burden that does not “more than adequately” compensate them in monetary terms.

Therefore, if introduction of LMOs do not provide increased monetary return to the farmers, it would not be possible to introduce labeling and IP procedures statutorily in the country. However, if the introduce LMOs ensures sizeable increased return and if such LMOs are accepted by the society for consumption, then only then introduction of statutory labeling policy and IP would be feasible.

CHAPTER 9
FEASIBILITY OF IP SYSTEM FOR LMOs IN INDIA

9.1 KEY CONSIDERATIONS FOR IP SYSTEM IN INDIA

Implementation of an IP system in India for LMOs has to take into account several factors such as international commitments, status of Indian agriculture, ensuring co-existence with other types of crops, labeling requirements adequacy in infrastructure and testing etc. Economic implications viz. implementing an effective IP system also need to be considered.

9.1.1 International context

With the introduction of LMOs in several countries, the trade involving LMOs has increased substantially and is likely to increase further in future. The Cartagena Protocol on Biosafety (CPB) is in place for putting in necessary procedures for transboundary movement of LMOs. The commitments under the CPB and decisions taken from time to time are the guiding principles for the world community in general.

CPB is for Parties that have been dealing with IP issues of LMOs, besides other issues. Presently the provisions in CPB are the legal instruments for dealing with transboundary movement of LMOs. The recommendations of the CPB have been the guiding principles for tackling the IP issues of LMOs to the world community.

Article 18 of the CPB requires exporters of LMOs for transboundary to identify the LMOs through unique identification traits and in this context identity preservation for LMOs assumes significance globally. In several COP-MOP meetings, particularly in COP-MOP 3 and thereafter, there had been substantial progress in the documentation requirement for LMOs FFP for their transboundary movement through a documentation accompanying the consignments. These include procedures for conditions dealing with different situations such as intended introduction, direct use for food, feed and processing and contained use.

Implementation of the provisions under Article 18 requires that every country involved in LMOs should preferably have in-house scientific, technological and administrative capabilities to identify the LMO consignments under different conditions of handling if such countries wish to stringently implement identity preservation methods particularly in the context of LMOs for direct use as FFPs. Further, countries also needed to have capabilities in identity preservation methods to deal with local situations emanating from the use of LMOs. The provisions of CPB do not prescribe any tolerance limit of LMO- FFPs for food, feed and processing. There is no unanimity among Parties on the extent of presence of LMOs in non-LMO consignments.

9.1.2 Status of Indian agriculture

There is an urgent need to create more innovative economic opportunities for millions of Indian farmers who earn their living from the land. Among the options include development and introduction of high yielding cultivars for raising productivity. Introduction of LMOs with prospects of ensuring economic gain cannot therefore be belittled. Introduction LMOs require resolving multiple societal issues including "right to know" for exercising for choice for products used as packaged food as well as grain package available for use as food, feed and food processing. People wish to know what they are buying or utilizing, which situation requires labeling of such products in trade.

In these multiple contexts, identity preservation methods of agricultural produce including LMOs may assume significance in the coming years in the country. As mentioned in earlier chapters, worldwide several LMOs are being developed for use in agriculture and India is also making substantial progress in this direction.

Indian agricultural output is essentially from marginal, small and medium land holders. The profession is leaned more towards subsistence than towards business. While Indian annual production of crops, oilseeds, fiber and sugarcane has been impressive making the country essentially self-reliant, the trend is yet not towards production of more value added crops. The profession is yet to emerge as a business like in other sectors although a small number of organized actors have chipped in to handling premium products to fetch increased margins. While the experience of such organized actors enables India to move from strength to strength during dealing with specific crops such as basmati rice, premium quality wheat, onion, potatoes, spices, tea, coffee, certain fruits & vegetables, such a situation cannot be imbibed upon and generalized for all cereals, pulses and oilseeds especially taking into consideration the present scenarios of economic conditions of management of small and even medium farmers. Introduction of value added traits such as IP requiring the implementation of SOPs, Records keeping etc. can be intensified with more experience, specially keeping in mind the needs and requirements of uplifting the economic and social conditions of the marginal and small farmers.

9.1.3 Coexistence

Coexistence of the three types of crops namely the GM crops as also the non-GM and organically grown crops is a natural phenomenon and is a practical issue for all countries. As there are considerable advantage in the use of GM crops of certain types, its cultivation will continue to increase with time and therefore it has to exist with other kinds of crops. Since presently there are issues of economic damage resulting from GM admixture in non-GM crops, segregation measures between GM crops and others are going to be more stringent and therefore several measures would be taken by different countries and such measures would have legislative teeth. However, no country would be able to establish procedures of zero tolerance of GM crops and therefore the coexistence measures would have to tolerate to some extent the presence of GM traits in non-GM consignments. All the 3 types of crops namely GM crops, non-GM traditional crops and organically grown crops would coexist. Identity Preservation methods for GM crops will therefore assume more significance. Presently, in India, the situation is not in sharp focus as no GM food crop is being cultivated in the country. It is however evident that several such crops are going to get authorization, as research in GM crop has been intensified to develop such crops.

9.1.4 Labelling

Among the two labelling policies such as statutory labelling policy and voluntary labelling policy of GM crops, it is suggested that the voluntary labelling policy would be more appropriate for implementation in Indian conditions. The labelling policy and the identity preservation procedures can be framed keeping these suggestions in view.

9.2 FEASIBILITY OF IMPLEMENTATION OF AN IP SYSTEM

In the future years, in the Indian context as well as the global context for dealing with identity preservation issues of GM substances, capacity building activities in all facets of handling GMOs starting from agricultural production system to harvesting, handling and consumption along with improving infrastructure capacities for detection and quantification of GM traits would assume great significance. Strengthening regulatory capacity building in environmental assessment and food safety assessment emanating from GMOs would also be required. Eventually the aim would be to use GM technologies safely in the environment with economic and societal gain.

9.2.1 Detection and testing capability

The primary requirement for implementing the provisions of identity preservation of LMOs in India is to have proven scientific methods for testing and quantification of all kinds of LMOs. Such methods will mostly be based on genetic testing especially by PCR based amplification methods utilizing specific primers. In India, national research institutions as well as private testing labs have capacity for the use of PCR based detection methods for LMOs. Validated procedures and detection kits are widely available for approval of LMOs in the country. Validated technologies have been used for authorizing experimentation and commercial approval in case of various events of Bt cotton seeds and varieties. Easy-to-use detection kits based on latex agglutination and ELISA are also widely available for use at various steps and stages in the supply chain, particularly at farmers' level or at "Mandi" for qualitative assessment of consignments. For other types of LMOs, capacity exists in the country for standardization and validation of detection methods.Therefore, India is scientifically prepared to adopt the system of labelling of GMOs in all kinds of target consignments and situations.

Identity preservation by the existing methods of phenotypic observation carried out in the case of **soybean** and **basmati rice** were studied and it was observed that the existing practices were inadequate tools to track the purity of the traded commodity from genetic angle. The existing system is essentially running on trust and trade can be severely jeopardized in regions where there is great resistance to accept transgenic cultivars. Although in certain situations, parties can resort to genetic testing methods, such practices are essentially not exhaustibly followed. Scientifically validated methods are available in the country to track the quality of samples drawn from various supply points for both soybean and rice to not only detect but to also quantitatively estimate the extent of transgenic traits in samples earmarked for evaluation. Such scientific methods are based on nucleic acid tests which are either available or can be tailor-developed in several formats and can be chosen for specific purposes by the regulatory authorities or by trade as would be required.

Genetic methods of identity preservation can be developed to identify specific varieties of non-GM soybean as well as non-GM basmati rice or any other non-GM rice. Therefore, on the basis of market needs identity preservation methods based on nucleic acid tests can be identified and included within the armoury of regulatory and trade authorities to authenticate trade samples when required.

If identity preservation procedures especially for GM products are introduced in India, there would also be a need to define the limits of presence of GM traits in non-GM consignments. Trade requirement and demand of non-GM food or non-GM grains may otherwise be affected. Societies would have to pay for the increased cost for the non-GM consignments that would emanate from such measures. For large consignments of non-GM grain trade, however, such costs are insignificant part of the total cost of production and can be absorbed by large commercial outfits dealing with different kinds of agricultural products in trade including exports.

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Several laboratories in the public sector are being strengthened to acquire skills in assessing GM traits in various agricultural consignments including seeds, grains and processing. Such laboratories would be capable of handling different social, commercial and legal issues relating to genetic identification and quantification of traits in agricultural products. Introduction of identity preservation methods for all types of agricultural products including GM products is therefore feasible in India.

9.3 ECONOMIC IMPACT OF IMPLEMENTING IP SYSTEM

Identity preservation and labelling costs in Indian conditions could not be assessed for LMOs because India has not authorized yet any GM grain for cultivation in the country. Only one GM technology namely Bt Cotton technology is in use in the country. Therefore, information from literature was gathered on cost of IP and labelling in other countries where LMOs are being cultivated and traded. Based on the literature data, it has been calculated that introduction of a rugged IP system would lead to increase in the prices of LMO grains when cultivated, from 6% to 17% more than the farm gate prices of such commodities without having to implement IP and labelling. Such additional costs seem to be substantial and may not justify imposition of statutory IP system and labelling.Therefore, under the present circumstances based on the limited study, it is suggested that introduction of labeling and implementation of IP for LMOs would have to be voluntary from the interests of small and medium farmers. There are apprehensions that introduction of voluntary labeling policy would agitate the vocal public demanding compulsory labeling of LMOs. These two extreme situations need to be balanced in order to make the implementation of IP and labeling policy successful.

9.4 WAY FORWARD

This study is limited to understand the steps involved in deploying IP and labelling for LMOs in agriculture and additional measures required for its effective implementation. The present study does not cover the potential economic impacts of introducing such a system in India especially the impact on marginal and small land-holders. As more experience is gained in India through the introduction of GM crops and more clarity/ unanimity is achieved on identification of LMO-FFPs under Article 2 (a) of CPB, a more advanced Techno-Economic feasibility study can then be undertaken to assess the economic implications of introducing IP and labelling in the cultivation of LMOs and use of LMO-FFPs in the country.

ANNEX-1

INDENT OF "BREEDER SEEDS" KHARIF 2015 AND KHARIF 2016

Zone	Seed Variety	Indented Qty 2015 (Quintals)	Indented Qty 2016 (Quintals)	Year of Release
Central Zone	Jawahar Soybean 95-60 (JS 95-60)	5443.3	5352.3	2007
	Jawahar Soybean 335 (JS-335)	4412.35	3893.0	1994
	Jawahar Soybean 93-05 (JS-93-05)	3266.3	2997.3	2002
	JS-20-29	-	945	2014
	JS 2034	-	842	2014
	Jawahar Soybean 97-52 (JS 97-52)	557.5	445.1	2008
	JS 320-24	-	105	2014
	AHILYA-3 (NRC-7)	-	88	1997
	AHILYA-4 (NRC-37)	65	84	2001
	AHILYA-6 (NRC-86)	-	30	2014
	RBS-2001-04	-	125	2014
Maharashtra	SAMRUDHI (MAUS-71)	784.45	534.75	2002
	MAUS-158	154.5	240	2010
	MAUS-81	22.5	-	2003
	MAUS-61	48.75	-	2001
	PHULE AGRANI	-	150	2014
	PHULE KALYANI (DS-228)	14.4	68.17	2006
	MAUS-162	-	50	2014
	MACS-1188	-	40	2014
	MACS-450	5.15	-	-
	PALAM SOYA (P-30-1-1)	-	1	2005
Rajasthan	PRATAP SOYA-2 (RKS-18)	25	10.5	2007
	PRATAP SOYA-45 (RKS-45)	-	285	2013
	PRATAP SOYA-1 (RAUS-5)	25	5	2007
	RKS-24	220	210	2011
Karnataka	DSb1	15	130.25	2009
	DSb21	-	200	2014
North Plain Zone	PANT SOYA-1092	16.06	0.8	2000
	PANT SOYBEAN-19 (PS-1368)	-	6	2013
	PANT SOYBEAN- 1042 (PK-1042)	1.38	2.25	1997
	PANT SOYBEAN- 1225 (PS-1225)	46.3	64	2009
	PANT SOYBEAN- 1347 (PS-1347)	37.98	12.75	2008
	SL 525	0.35	-	2007
	SL 744	1.70	-	2012
	PUSA 9712 (DS-9712)	40	15	2005
North Hill Zone	VL SOYA-65	1.64	3.38	2010
	VL SOYA-47	0.16	-	2000
	HARA SOYA (HARIT SOYA)	2	2	2001
	SHIWALIK (HIM SO-333)	2	2	1990
Jharkhand	BIRSA SOYBEAN-1	-	0.5	1983
		15208.77	**16940.05**	

ANNEX-2

MOLECULAR METHODS FOR IDENTIFICATION OF SOYBEAN VARIETIES

The scientists of ICAR Directorate of Soybean Research, Indore extracted and purified the DNA from the above six commercial soybean varieties from the leaves of 10-15 days old plant using standard protocol. The following **table** provides the details about the six soybean varieties along with their pedigree, year of release and breeding centre[117].

Details of six soybean varieties with Pedigree, Year of Release and Breeding Centre

Variety	Pedigree	Year of Release	Breeding Centre
JS335	JS78-77 X JS71-5	1994	JNKVV, Sehore
NRC7	Selection from S69-96	1997	NRC for Soybean
NRC37	Gaurav X Punjab 1	2001	NRC for Soybean
JS93-05	Secondary selection from PS73-22	2003	JNKVV, Jabalpur
JS95-60	Selection from PS73-22	2006	JNKVV, Jabalpur
JS97-52	PK237 X L129	2008	JNKVV, Jabalpur

The scientists used ten SSR primer pairs. The sequences of these markers were obtained from the Soybean SSR *loci* mapped by the Agricultural Research Services, United States Department of Agriculture[118]. The scientists got the primers synthesized from Sigma Aldrich, Bangalore, India. The following **table** gives the details of the ten SSR primer sequence pairs with their sequences, used by the scientists as also the alleles and polymorphic information content (PIC) values[26]:

SSR Primer Sequence Pairs with their Sequences, Alleles and PIC

S. No.	Primer Pair	LGp	Sequence of forward and reverse primers	Alleles	PIC
1	Satt538	A2	F 5' GCAGGCTTATCTTAAGACAAGT 3' R 5'-GGGGCGATAAACTAGAACAGGA-3'	2	0.277
2	Satt577	B2	F 5'-CAAGCTTAAGTCTTGGTCTTCTCT-3' R 5' GGCCTGACCCAAAACTAAGGGAAGTG-3'	3	0.500
3	Satt267	D1a	F 5'-CCGGTCTGACCTATTCTCAT-3' R 5'-CACGGCGTATTTTTATTTTG-3'	2	0.277
4	Satt146	F	F 5'-AAGGGATCCCTCAACTGACTG-3' R 5'-GTGGTGGTGGTGAAAACTATTAGAA-3'	2	0.444

117 Kumar V, Molecular Identification of Dominant Cultivars of Soybean Using Simple Sequence Repeat Markers, http://link.springer.com/article/10.1007%2Fs40011-015-0641-7

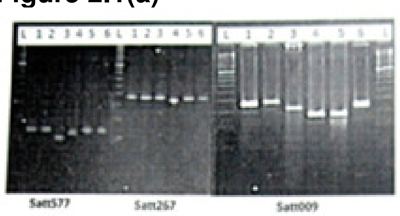
118 Mapped Soybean SSR Loci July 2006, http://bldg6.arsusda.gov/cregan/soymap.htm

S. No.	Primer Pair	LGp	Sequence of forward and reverse primers	Alleles	PIC
5	Satt352	G	F 5'-GCGAATGTATTTTGTTTCTCCATCAA-3' R 5'-TGATAAGCCAAAAAATGGAAGCATAG-3'	3	0.611
6	Sct_199	G	F 5'-GCGACAATGGCTATTAGTAACAATCA-3' R 5'-GCGATTTTCTATTTTCCTCACAGTG-3'	3	0.612
7	Satt541	H	F 5'-GCGAATCCATCACACATAAA-3' R 5'-GCGGTACTCCCTCCAGAAAATAACC-3'	3	0.500
8	Satt181	H	F 5'-TGGCTAGCAGATTGACA-3' R 5'-GGAGCATAGCTGTTAGGA-3'	2	0.450
9	Satt229	L	F 5'-TGGCAGCACACCTGCTAAGGGAATAAA-3' R 5'-GCGAGGTGGTCTAAAATTATTACCTAT-3'	1	0.000
10	Satt009	N	F 5'-CCAACTTGAAATTACTAGAGAAA-3' R 5'-CTTACTAGCGTATTAACCCTT-3'	3	0.611

Note: LGp refers to Linkage Group Position of Mapped Soybean SSR Loci; information obtained from http://bldg6.arsusda.gov/cregan/soymap.htm. PIC refers to Polymorphic Information Content value calculated based on standard practices. An allele is one of a number of alternative forms of the same genetic locus.

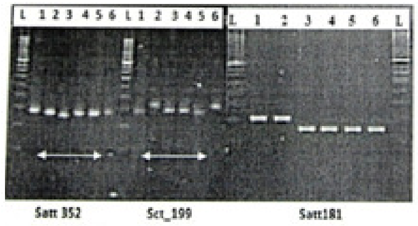
The genomic DNA of the six commercial soybean varieties amplified by PCR using the ten SSR markers as above is shown in the following three figures(Figure2.1(a) 2.1(b) and 2.1(c)).

Figure 2.1(a)



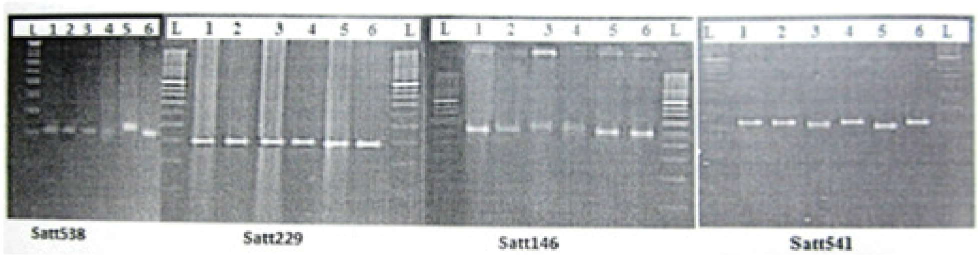
PCR amplification pattern of six soybean varieties using Satt577, Sat267 and Sat009, Lanes 1, 2, 3,4,5,6 are loaded with amplicons from varieties NRC7, JS93-05, JS97-52, NRC37, JS335, JS95-60 respectively while Lane L denotes the DNA ladder (50 bp).

Figure 2.1(b)



PCR amplification pattern in six soybean varieties using Satt352, Sct_199 and Satt181, Lanes 1,2,3,4,5,6 are loaded with amplicons from varieties NRC7, JS93-05, JS97-52, NRC37, JS335 and JS95-60 respectively while Lane L denotes the DNA ladder (50 bp).

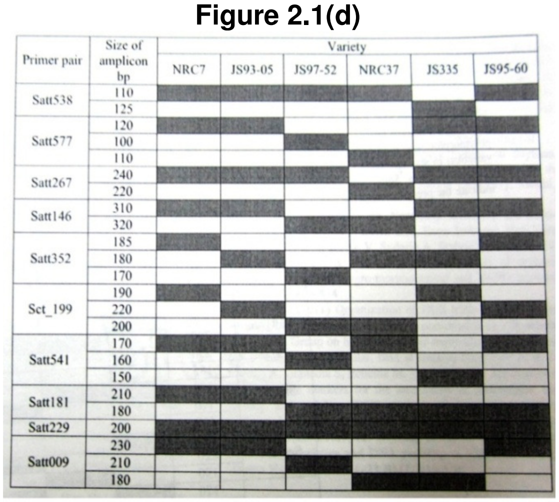
Figure 2.1(c)



PCR amplification pattern in six soybean varieties using Satt538, Satt229, Satt14 and Satt541, Lanes 1, 2,3,4,5,6 are loaded with amplicons from varieties NRC7, JS93-05, JS97-52, NRC37, JS335 and JS95-60 respectively while Lane L denotes the DNA ladder (50 bp).

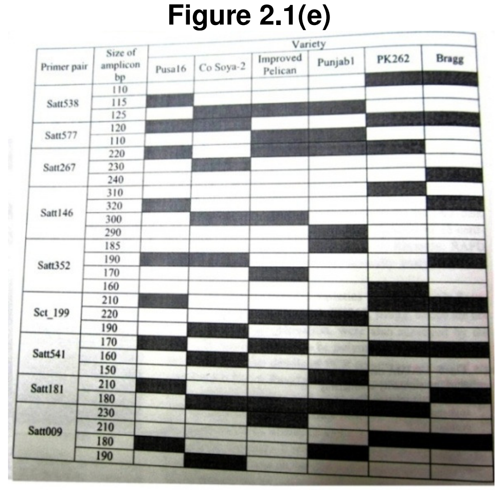
The details of the results of the PCR fragments generated through the STR markers for the six soybean commercial varieties have been summarized in the following Amplicon profiles (Figure 2.1(d)). Similar Amplicon profiles were generated by analyzing another six non-trading soybean varieties such as Pusa16, Co Soya-2, Improved Pelican, Punjab1, PK262 and Bragg. The Amplicon profiles of those six non-commercial varieties are also placed below in the figure 2.1(e). The two summarized results of the Amplicon profiles demonstrated the differences between the individual soybean varieties[26].

Figure 2.1(d)



Amplicon profile as generated by 1- SSR primer pairs in six dominant commercial soybean varieties. Solid cells indicate the presence of allele

Figure 2.1(e)



Amplicon profile as generated by nine SSR primer pairs (nine found to be polymorphic with dominant varieties) in six non-trading soybean varieties. Solid cells indicate the presence of allele

The procedures described above clearly indicate that Amplicon profile obtained through the SSR markers could differentiate each soybean variety. This technique can therefore be employed to address the genetic purity issues of newer soybean varieties (when developed)as also to more precisely address the issues of Intellectual Property Rights / breeders rights on protected seeds that are expected to emanate through the Indian IPV&FRA.

ILLUSTRATIVE INFORMATION SHOWING HOW GM TRAITS ANALYZED BY MOLECULAR IDENTIFICATION METHOD

Soybean is used in food and feed chain in various forms such as defatted soy flower, soy granules, soy meat, so tofu, soy cream, soy milk, soy coffee etc. In such processed food GM trait if present can be identified by genetic testing methods. Herbicide resistant GM Soybean known as Roundup Ready (RR) Soybean was invented by Monsanto Inc., USA and was introduced first in USA in 1994 and thereafter it spread in several parts of the world including Brazil, Argentina etc. The RR Soybean contains a portion of 35S promoter sequence (E35S) from Cauliflower Mosaic virus (CaMV), a CTP4 leader sequence from Petunia hybrida, the 5-anol-pyruvyl skikimat-3-phosphate synthase (EPSPS) gene from Agrobacterium tumefaciens and a nopaline synthase (nos 3') transcriptional termination element from Agrobacterium tumefaciens[119].The presence of such GM Soybean can be established by amplification of either portions of the 35S promoter sequence or the NOS terminator sequence, both of which are not parts of non-GM Soybean varieties. Several methods are available and one is described in detail below, which can be used for assessing the presence of GM traits in any soybean types such as whole soybean seeds as also the processed materials such as various soybean flour, soybean granules etc. which are sold as food based on soybean.

DNA can be extracted from Soy samples using any standard technique. One such technique is described by M. Somma[120]. Some Soy samples may require some modification from the original protocol of M. Somma as shown in the following table.

Modifications used in CTAB DNA extraction

Particulars	Original Protocol	Soy Flour	Soy Chop Meat	Soy Meat	Tofu	Soy Milk & Cream	Soy Sprouts	Soy Coffee
Starting Material (mg)	100	-	200	-	300	200	200	-
dH_2O (µl)	300	-	600	-	-	-	-	-
Extra chloroform step	-	+	-	-	-	-	-	-
CTAB(µl)	500	-	-	-	-	-	1000	-
CTAB precipitation buffer	2 volumes	-	-	-	-	-	4 volume	4 fold volum e
NaCl(µl)	350	500	-	-	-	-	-	-
Last Centrifuge	10 min.	10 min.	-	-	-	20 min.	10 min.	-

-Means no change from original protocol

[119] Genetically modified soybean, WIKI, https://en.wikipedia.org/wiki/Genetically_modified_soybean
[120] M. Somma, The Analysis of Food Samples for the Presence of Genetically Modified Organisms, Session 4, Extraction and Purification of DNA, http://gmo-crl.jrc.ec.europa.eu/capacitybuilding/manuals/Manual%20EN/Session04.pdf

The quality as also the quantity of DNA solutions were assessed by UV spectroscopy by measuring the absorbance at 260 nm and 280 nm. Genomic DNA was extracted by the CTAB method (as described in the reference of M. Somma) was subjected to Agarose gel electrophoresis which produced clear DNA bands as shown below in the following diagram/**Figure 3.1**:

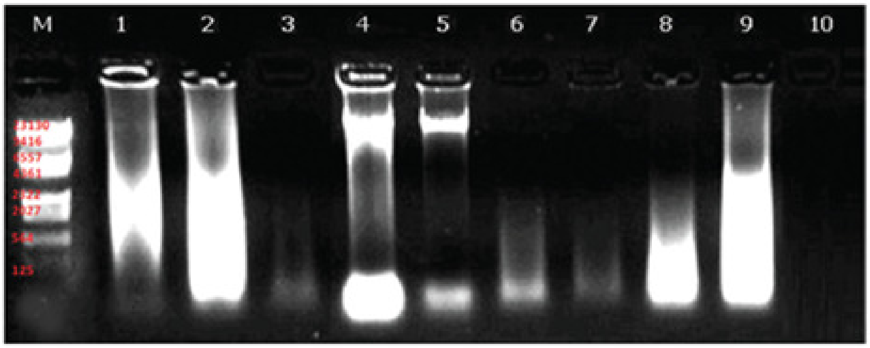


Figure 5.3.1. Agarose gel electrophoresis (1.8%) of genomic DNA using the CTAB method with 3 replications. M: Marker, Fermentas SM0103, 1) Soy flour; 2) Soy meat; 3) Soy cream; 4) Soy sprout-1; 5) Soy sprout-2; 6) Soy milk; 7) Soy coffee; 8) Tofu; 9) Soy chop meat; 10) Isolation blank control.

Primers that were used for magnifying the DNA sequence were chosen from other published work and quantitative real time PCR was also performed according to published information. The following **table** provides the primers and the probes used in the PCR reaction.

Primers and probes used in PCR reaction

Target	Primer/Probe	Sequences (5'-3')	Product size (bp)
		CONVENTIONAL PCR	
Lectin	GMO3 GMO4	GCCCTCTACTCCACCCCCATCC GCCCATCTGCAAGCCTTTTTGTG	118
35S promoter	P35S-cf3 P35S-cr4	CCACGTCTTCAAAGCAAGTGG TCCTCTCCAAATGAAATGAACTTCC	123
NOS terminator	tNOS 2-5' tNOS 2-3'	GTCTTGCGATGATTATCATATAATTTCTG CGCTATATTTTGTTTTCTATCGCGT	151
		REALTIME PCR	
Lectin gene	Le1no2-5 Le1no2-3 Le1-Taq	GCCCTCTACTCCACCCCCA GCCCATCTGCAAGCCTTTTT FAM-AGCTTCGCCGCTTCCTTCAACTTCAC-TAMRA	118
CTP4-CP4 EPSPS	RRS 01-5 RRS 01-3 RRS-Taq	CCTTTAGGATTTCAGCATCAGTGG GACTTGTGGCCGGGAATG FAM-CGCAACCGCCCGCAAATCC-TAMRA	121

Note: FAM stands for fluorescein amidite and TAMRA stands for tetramethylrhodamine

The PCR amplified DNA were subjected to Agarose gel electrophoresis where amplification of 35S promoter and NOS terminator was undertaken. The following **figure 3.2** shows that the amplified DNA contained transgenic Soy DNA.

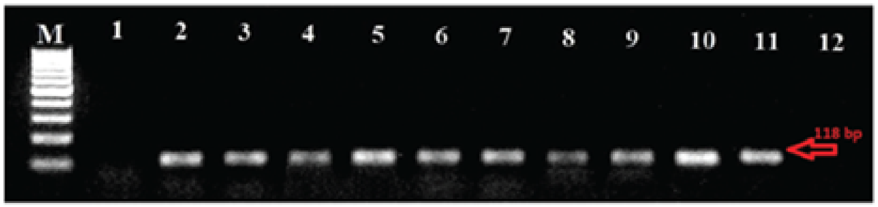


Figure 5.3.2. Agarose gel electrophoresis (1.8%) of amplification products of lectin from samples 1) Corn DNA (negative control); 2) % 0 SRM (positive control) 3) Soy flour; 4) Soy meat; 5) Soy cream; 6) Soy milk; 7) Soy sprout-1; 8) Soy sprout-2; 9) Soy coffee; 10) Tofu; 11) Soy chop meat; 12) no template control; M) Marker (Fermentas, GeneRulerTM 100 bp DNA Ladder, 100-1000 bp).

Most samples were positive for P35S promoter and NOS terminator as revealed in the **figures 3.3** and **3.4**.

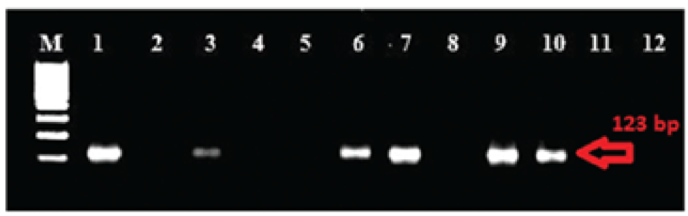


Figure 5.3.3. Agarose gel electrophoresis (1.8%) of amplification products of 35S promoter from samples 1) % 2 SRM (positive control); 2) % 0 SRM (negative control); 3) Tofu; 4) Soy sprout-1; 5) Soy sprout-2; 6) Soy chop meat; 7) Soy flour; 8) Soy meat; 9) Soy cream; 10) Soy milk; 11) Soy coffee; 12) No template control; M) Marker (Fermentas, GeneRulerTM 100 bp DNA Ladder, 100-1000 bp).

Figure 5.3.4. Agarose gel electrophoresis (1.8%) of amplification products of NOS terminator from samples. 1) % 2 SRM (positive control); 2) % 0 SRM (negative control); 3) Tofu; 4) Soy sprout-1; 5) Soy sprout-2; 6) Soy chop meat; 7) Soy flour; 8) Soy meat; 9) Soy cream; 10) Soy milk; 11) Soy coffee; 12) No template control; M) Marker (Fermentas, GeneRulerTM 100 bp DNA Ladder, 100-1000 bp).

The above figures and the information of PCR of identification of transgenic traits in GM Soybean were obtained from published information[121,122,123,124].

[121] Mandaci M et. al, Detection of genetically modified organisms in soy products sold in Turkish market, Food Sci. Technol,

Protocols can be developed for ascertaining transgenic GM traits of Soybean in almost all kinds of Soy products and food that contain the DNA element in them. The above is only an illustration to show that transgenic traits can easily be determined and quantified by amplifying the DNA obtained from such products.

Campinas, 34(4): 717-722, Oct.-Dec. 2014, http://www.scielo.br/pdf/cta/v34n4/v34n4a11.pdf

[122] M. Querci, M. Mazzara, The Analysis of Food Samples for the Presence of Genetically Modified Organisms, Session 7, Characteristics of Roundup Ready Soybean, MON810 Maize, and Bt-176 Maize, JRC European Commission, http://gmo-crl.jrc.ec.europa.eu/capacitybuilding/manuals/Manual%20EN/Session07.pdf

[123] Lee S et. al, Functional analyses of the flowering time gene OsMADS50,the putative SUPPRESSOR OF OVEREXPRESSION OF CO 1/AGAMOUS-LIKE 20 (SOC1/AGL20) ortholog in rice, The Plant Journal (2004) 38, 754- 764, http://onlinelibrary.wiley.com/doi/10.1111/j.1365-313X.2004.02082.x/epdf

[124] Kuribara H et. al, Novel reference molecules for quantitation of genetically modified maize and soybean, JAOAC Int. 2002 Sep-Oct;85(5):1077-89, http://www.ncbi.nlm.nih.gov/pubmed/12374407

ANNEX-4

EXPORT OF BASMATI RICE FROM INDIA TO VARIOUS COUNTRIES IN THE LAST 3 YEARS

Country	2012-13		2013-14		2014-15	
	Qty	Value	Qty	Value	Qty	Value
Saudi Arab	681193	365908	826119	671706	966931	726078.26
Iran	1082219	646350	1440454	1097571	935568	675896.95
U Arab Emts.	234640	131120	147903	118596	278601	192996.56
Iraq	204266	107667	219605	159972	235448	158738.67
Kuwait	163317	105968	175537	151306	166469	153322.63
Yemen Republic	172350	87819.4	146840	110779	174370	120100.3
Qatar	61188	40377.4	29555	26220.6	124115	113837.73
U K	192435	84998.5	118852	78574.5	136396	90013.06
U S A	91544	56169.1	103391	87030.8	89223	80540.1
Jordan	89645	44136.5	79094	62408.7	61815	45766.76
Oman	40103	24436.3	43145	35545.6	56264	42228.8
Netherland	60059	28888.6	43533	29902.4	52233	36476.33
Australia	20264	14539	23298	20658.3	27313	25422.11
Mauritius	25633	16004.4	26492	21796	28690	23424.95
Canada	28147	17080.5	28826	23154.9	25666	22966.48
Belgium	54960	26473	34498	24177.2	29900	22214.35
Italy	41374	19484.4	39840	28491.7	31467	21796.67
Baharain Is	18763	11931.2	21087	17918.5	23819	18678.26
Israel	12973	7576.15	15504	12441.1	19183	15201.21
Turkey	3508	1644.53	11502	8554.96	24156	14851.05
Germany	15991	8696.96	9295	8335.9	13512	11880.26
France	18949	9034.6	18972	12702.6	18010	11048.6
Georgia	17861	11230.5	15839	13161.3	13811	9725.67
Malaysia	5862	3952.09	6393	5305.16	12313	9469.15
Syria	5848	3153.6	8062	6422.65	13122	9224.75
South Africa	10061	6349.46	11004	9479.08	9764	8565.08
Singapore	7107	4991.54	7364	6738.33	8107	7610.7
Azerbaijan	6090	3767.43	14064	11865	10272	7430.71
Egypt A Rp	7527	4131.75	8509	6174.08	9961	6897.8
Reunion	10558	5464.18	6314	4756.62	9159	6641.25
Lebanon	3511	2353.91	5532	4891.92	6972	5726.98
Sweden	3834	2275.87	4313	3544.7	5744	4482.81
Switzerland	4275	2610.04	3011	2885.57	3580	4148.8
Tanzania Rep	3384	1857.29	3684	2984.09	5250	3762.11
Algeria	876	478.23	1794	1581.84	4054	3268.55
New Zealand	3384	1986.99	3473	2633.5	4023	3154.05
Seychelles	3874	2008.23	3958	2464.13	4879	2979.03
Poland	3143	1426.79	2316	1520.48	4719	2616.28
Portugal	3376	1510.3	3952	2707.52	4328	2368.31
Benin	1070	655.95	2193	1647.9	3119	2272.61
Spain	11656	5707.98	5696	4477.09	3143	2262.58
Kenya	2943	1606.28	1375	894.22	3275	2189.59
Norway	2097	1506.21	2218	2224.36	2115	2167.07

Country	2012-13		2013-14		2014-15	
	Qty	Value	Qty	Value	Qty	Value
Unspecified			1356	1299.57	3449	2143.07
Sudan	803	407.6	982	657.46	2854	2113.52
Somalia	672	242.54	1868	1093.53	3287	1802.32
Djibouti	1828	841.74	1837	1271.42	3206	1710.51
Ethiopia	833	440.54	1474	1020.53	2222	1438.29
Greece	1203	591.81	1590	1204.11	1749	1239.28
Angola	883	584.18	861	795.24	1487	1236.25
Mauritania	1360	766.01	2687	1806.59	1479	1052.85
Russia	789	495.85	1410	1292.3	1190	1048.57
Nigeria	1039	540.92	1144	867.51	1337	1022.55
Thailand	468	307.66	576	499.57	1024	848.23
Austria	505	413.21	448	507.21	872	813.88
Hong Kong	882	550.13	1127	923.01	937	811.38
Denmark	580	344.99	453	377.69	963	750.12
Pakistan Ir	3128	1686.17	823	550.83	1314	719.31
Bangladesh Pr	101	66.06	502	375.19	818	640.86
Mozambique	488	324.77	597	471.11	732	570.78
Sri Lanka Dsr	231	130.61	240	197.94	619	441.77
Cyprus	706	456.61	706	566.26	573	441.24
Libya	293	191.42	1291	990.52	543	395.65
Maldives	288	186.21	396	299.61	512	395.47
Jamaica	257	191.49	347	323.73	402	394.22
Senegal	38	17.42	37	27.93	496	351.38
Ireland	168	106	236	201.14	428	319.27
Japan	182	121.97	200	198.6	236	312.22
Guadeloupe	643	302.15	713	487.06	536	297.76
Brunei	239	161.84	310	269.38	297	280.94
Morocco	106	78.82	263	227.47	277	266.16
Trinidad	130	110.18	171	170.2	244	264.59
Ghana	779	303.36	188	159.11	334	263.91
Botswana	197	136.61	325	238.3	342	256.72
Indonesia	155	98.38	478	306.89	258	243.25
Ukraine	829	505.79	799	677.48	333	237.21
Hungary					333	231.57
Cameroon	111	54.24	129	80.29	284	212.87
Equtl Guinea	178	124.08	342	276.6	215	187.37
Fiji Is	260	160.71	298	245.07	234	184.16
Congo P Rep	343	189.89	240	190.04	209	177.25
Nepal	349	173.97	60	30.88	356	165.86
Afghanistan Tis	1553	805.92	48	29.48	258	158.17
Tunisia	475	278.86	325	227.02	200	145.71
Czech Republic	98	62.68	34	28.17	219	139.97
Martinique	32	20.98	54	45.72	247	134.37
Haiti			25	14.79	216	129.57
Comoros	235	159.96	151	122.53	155	129.26
Lithuania	271	178.86	69	69.89	170	128.33
Congo D. Rep.	2	2.77	17	12.3	152	121.95

Country	2012-13		2013-14		2014-15	
	Qty	Value	Qty	Value	Qty	Value
C Afri Rep					198	119.02
Mexico					132	112.24
Swaziland	207	172.06			172	106.1
Chile	141	76.08	119	103.41	107	100.02
Taiwan	63	46.84	72	64.13	92	97.62
Cote D' Ivoire	365	106.96	53	47.44	107	94.41
Gabon		0.25	18	14.93	109	87.74
Guinea	130	81.82	23	20.76	116	80.85
Philippines	18	16.54	22	23.95	80	74.04
Romania	106	65.37	44	39.91	93	71.8
Korea Rp	20	12.99	6	3.17	93	69.29
Finland	139	86.4	82	73.95	81	64.31
Burundi					94	59.31
Mali	69	26.86			100	59.18
Brazil	23	20.91	33	36	48	55.08
Zimbabwe	154	47.81	8	9.55	53	52.16
Zambia	19	11.88	31	23.9	65	47.93
Kyrghyzstan			22	11.12	64	47.26
Gambia	56	33.84	20	16.02	176	44.5
Madagascar	351	113.3	73	59.33	139	41.83
Croatia	67	30.06	10	7.89	59	41.59
Belarus	63	52.21	105	85.13	30	35.21
Estonia	20	14.31	39	35.34	43	34.89
Togo	167	97.21	92	80.41	45	34.34
Uganda	154	92.22	97	77.87	60	34.27
Cayman Is	46	32.95	42	37.06	40	33.93
Latvia			38	32.81	39	32.66
Namibia					42	32.34
Malawi			15	8.3	41	29.11
Argentina	49	17.93	21	23.75	20	27.76
Venezuela	20	19.19	38	38.46	20	21.7
Netherlandantil	9	6.59	25	11.79	23	21.51
Malta			20	17.18	25	21.5
Bulgaria	121	68.7			25	20.46
Cape Verde Is					25	20.43
Korea DpRp				0.12	23	20.12
Cambodia	1	1.04	14	13	18	17.07
Kazakhstan	29	14.91	23	16.97	28	15.93
Turkmenistan	44	27.93	115	99.18	24	13.54
Tajikistan					21	13.07
Liechtenstein					14	12.46
Paraguay					9	7.65
Macao			10	10.11	7	6.44
Vietnam Soc Rep	3	1.03	4	4.4	5	6.36
Suriname	9	6.21	2	2.46	7	6.27
Mongolia	5	3.24	3	2.61	6	5.06
Liberia		0.03		0.05	2	2.17

Country	2012-13		2013-14		2014-15	
	Qty	Value	Qty	Value	Qty	Value
Bosnia-Hrzgovin					2	1.64
Cuba					2	1.2
Uruguay					1	1.15
Guyana			2	2.84	1	0.56
Armenia					1	0.45
Iceland						0.01
Costa Rica	5	4.75				
Albania			1	0.31		
Bermuda	14	2.72				
Bhutan	196	111.43				
Burkina Faso	66	31.96				
Chad		0.17				
China P Rp	1	0.32	29	20.21		
Moldova			12	10.54		
Niger	130	46.43	7	4.25		
Peru	10	9.48				
Papua N Gna		0.03				
Slovak Rep	171	82.39	75	57.82		
Slovenia			4	3.21		
TOTAL[125]	**3459236**	**1940649**	**3753974**	**2929086**	**3702284**	**2759871.4**

(QTY in MT, Value in Rs. Lakhs)

[125] Export Statistics of Basmati rice, AIREA, http://www.airea.net/page/58/statistical-data/export-statistics-of-basmati-rice

ANNEX-5

VARIETY OF BASMATI RICE NOTIFIED BY THE GOVT. OF INDIA

S. No.	Variety	Notification No. & Date	Released from
1	Basmati 217 (Traditional)	4045 – 24.09.1969 361 (E) – 30.06.1973	P A U, Kapurthala Out of Cultivation
2	Basmati 370 (Traditional)	361 (E) – 30.06.1973 786 – 02.02.1976	Govt. Farm, Kalashahkaku
3	Type 3 (Dehraduni Basmati) Traditional	13 – 19.12.1978	R RS, Nagina
4	Punjab Basmati 1 (Bauni Basmati)	596 (E) - 13.08.1984	P A U , Ludhiana
5	Pusa Basmati 1	615 (E) - 06.11.1989	IARI, New Delhi
6	Kasturi	615 (E) - 06.11.1989	D R R, Hyderabad
7	Haryana Basmati 1	793 (E) - 22.11.1991	H A U, Kaul
8	Mahi Sugandha	408 (E) - 04.05.1995	R A U, Bikaner
9	Taraori Basmati (HBC 19 / Karnal Local) Traditional	1 (E) – 01.01.1996	H A U, Kaul
10	Ranbir Basmati (Traditional)	1 (E) - 01.01.1996	RARS, R S Pura
11	Basmati 386 (Traditional)	647 (E) – 09.09.1997	P A U, Kapurthala
12	Improved Pusa Basmati 1 (Pusa 1460)	1178 (E) – 20.07.2007	IARI, New Delhi
13	Pusa Basmati 1121 After amendment	1566 (E) – 05.11.2005 2547 (E) - 29.10.2008	IARI, New Delhi
14	Vallabh Basmati 22	2187 (E) – 27.08.2009	SardarVallabh Bhai Patel University of Agriculture & Technology, Meerut
15	Pusa Basmati 6 (Pusa 1401)	733 (E) – 01.04.2010	IARI, New Delhi
16	Punjab Basmati 2	1708 (E) – 26.07.2012	P A U, Ludhiana
17	Basmati CSR 30 After amendment	1134(E) – 25.11.2001 2126 (E) – 10.09.2012	CSSRI, Karnal
18	Malviya Basmati Dhan 10-9 (IET 21669)	2817 (E) – 19.09.2013	BHU, Varanasi
19	Vallabh Basmati 21 (IET 19493)	2817 (E) – 19.09.2013	SardarVallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut
20	Pusa Basmati 1509 (IET 21960)	2817 (E) – 19.09.2013	IARI, New Delhi
21	Basmati 564	268 (E) – 28.01.2015	SKUAST Jammu
22	Vallabh Basmati 23	268 (E) – 28.01.2015	SardarVallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut
23	Vallabh Basmati 24	268 (E) – 28.01.2015	SardarVallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut

TRANSGENIC CONSTRUCTS BEING EXPERIMENTED UPON IN RICE

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice

Cultivar/Variety	Transformation method	Construct	Comments
		Biotic stress	
Kinuhikari, Nipponbare	Electroporation	p*35S*-i1(*CATB*)-*RSV CP*-*nos*t	Resistance to rice stripe virus
Nipponbare	Electroporation	p*35S*-i1(*CATB*)-*cry1Ab*-*nos*t	Resistance to striped stem borer and leaf folder
Taipei 309	Bombardment	*Xa1* genomic fragment	Resistance to *Xanthomonas oryzae* pv. *Oryzae*
Nipponbare, Tainung, Pi4	Bombardment	p*PINII*-i(*ACT1*)-*PINII*-*PINII*t	Resistance to major insect pest, pink stem borer
Taipei 309	Electroporation	p*35S*-*BMV RNA2*-*tRNA*-*nos*t, p*35S*-*CP*-*tRNA*-*nos*t, p*35S*- As *BMV RNA3*-*tRNA*-*nos*t	Virus resistance mediated through RNA
Nipponbare	Electroporation	p*35S*-*CC*-*nos*t	Inhibition of proteinases in insect gut
IR58	Bombardment	p*35S*-*cry1Ab*-i (*PEPC*)-*35S*t	Tolerance to several lepidopteron insect pests
Taipei 309	Bombardment	p*ACT*-*CPTI*-*nos*t	Resistance to two major rice insect pests
Taipei 309	Bombardment	p*35S*-*cryIIIA*- *nos*t	Rice was transformed with modified *cry* gene
IR64	Bombardment	p*UBI1*-i1(*UBI*)-*cry1Ac*-*nos*t	Resistance to yellow stem borer
Tarom Molaii	Bombardment	p*PEPC*-*cry1Ab*-i9(*PEPC*)-*35S*t	Enhanced resistance to striped stem borer and yellow stem borer
Taipei 309	Bombardment	p*ACT1*-i(*ACT*)-*cry1Ab*-*nos*t	Resistance to yellow stem borer
Vaidehi (TCA48)	Bombardment	p*35S*-*cry1Ab*-i(*PEPC*)-*35S*t	Enhanced resistance to yellow stem borer
IR64, IR72, CBII, IR51500, IR68899B, MH33, Vaidehi, NPT, Taipei 309	Bombardment	p*ACT*-i(*ACT*)- *cry1Ab*-*nos*t, *p35S*-*cry1Ab*-i(*PEPC*)-*35S*t, p*PEPC*-*cry1Ab*-i(*PEPC*)-*35S*t, p*PITH*-*cry1Ab*-i(*PEPC*)-*35S*t	Resistance to lepidopteran pests
Nipponbare	Ag	p*35S*-*cry1Ab*-*nos*t, p*BP10*-*cry1Ab*-*nos*t, p*UBI*-*cry1Ab*-*nos*t, p*UBI*-*cry1Ac*-*nos*t	Resistance to striped stem borer and yellow stem borer
ASD16, M5, M12, FX92	Bombardment	p*UBI*-*GNA*-*nos*t p*RSS1*-*GNA*-*nos*t	Resistance to brown plant hopper
IR72	Bombardment	p*35S*-*Xa21*-*35S*t	Resistance to bacterial blight
Taipei 309	Bombardment	p*UBI*-i(*UBI*)-*REP*-*nos*t, p*UBI*-i(*UBI*)-As*REP*-*nos*t	Resistance to RTSV
Kinuhikari	Electroporation	p*35S*-*VEF*-*nos*t	Protection to army worm larvae
Nagdongbyeo	PEG	p*35S*-*SKT1*-*nos*t	Resistance to brown plant hopper

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Bouaké 189, ITA 212 , BG 90-2	Bombardment	p*35S-RYMV ORF2-nos*t	Resistance to rice yellow mottle virus strains
TN1,Taipei 309	Bombardment	p*UBI1*-i(*UBI*)-*RTSVCP1/2/3-nos*t	Resistance to RTSV
Ariete, Senia	Bombardment	p*UBI1*-i(*UBI*)-*cry1B-nos*t	Protection against striped stem borer
Tongling 1	Ag	p*35S-RZ-nos*t, p*35S-mRZ-nos*t	Resistance to rice dwarf virus
Minghui 63, Shanyou 63	Bombardment	p*ACT1*-fused *cry1Ab-cry1Ac-nos*t	Resistance to leaf folder and yellow stem borer
Nipponbare	Ag	p$E_7\Omega$ i(*Phaseolin*)- *CECB-nos*t p$E_7\Omega$-i(*Phaseolin*)-SP-*mCECB-nos*t	Resistance to *Xanthomonas oryzae* pv. *Oryzae*
Taipei 309	Bombardment	p*35S*-i(*RTBV*)-*Rir1b-35S*t	Resistance to *Magnaporthe grisea*
Xiushui	Ag	p*35S-cry1Ab-nos*t, p*BP10-cry1Ab-nos*t, p*UBI-cry1Ab-nos*t, p*UBI-cry1Ac-nos*t	Resistance to lepidopteran insects
Nipponbare	Bombardment	*Pi-ta* genomic fragment	Protection against *Magnaporthe grisea*
Taipei 309	Bombardment	p*UBI1-C2-nos*t	Resistance to *Magnaporthe grisea*
M7, Basmati 370	Bombardment	p*UBI1-cry1Ac*-t, p*35S-cry2A*-t p*UBI1-GNA*-t	Protection against rice leaf folder, yellow stemborer and brown plant hopper
Eyi105	Bombardment	p*35S*-SP-*AP1-nos*t	Resistance to *Xanthomonas oryzae*
IR72, IR64, IR68899B, MH63	Bombardment, PEG	p*35S-RC7*-t	Resistance to sheath blight
Kinmaze	Ag	p35S-OsRAC1-G19V-t, p*35S*-Os*RAC1-T24N*-t	Resistance to *Xanthomonas oryzae* pv. *Oryzae* race 1
Ariete	Bombardment	p*C1*-i(*C1*)-*cry1B-nos*t	Complete protection against rice stem borer
Taipei 309	Ag	p*35S-NPR1-nos*t p*UBI-NPR1-nos*t	Resistance against *Xanthomonas oryzae*
Xiushui 11, Chunjiang 11	Ag	p*35S-SPI*-t	Resistance to leaf folder and striped stem borer
Ayi105, Bengal	Bombardment	p*UBI-GNA-nos*t, p*UBI-cry1Ac-nos*t	Protection against brown plant hopper and striped stem borer
Nipponbare	Ag	p*UBI-OSYK1*-t	Increased tolerance towards rice blast and other environmental stress
IR-50	Bombardment	p*35S-Xa21-35S*t	Enhanced blight resistance
IR 72	Crossing of transgenic lines	*Xa21, Bt(cry1AB, cry1Ac), Chitinase*	Resistance to bacterial blight

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Zhonghua	Bombardment	p*35S-TCS-nos*t	Resistance to fungal blast disease
Senia	Bombardment	p*UBI-cry1B-nos*t	Protection against striped stem borer
Chiyohonami	Ag	E_7p*35S*Ω-i-*Asthi1*- *nos*t	Protection against seed transmitted phytopathogenic bacteria *Burkholderia plantarii* and *B. glumae*
Sasanishiki	Ag	p*UBI1-DEFENSIN-nos*t	Resistance to rice blast
IR-64, Pusa Basmati1, Karnal Local	Ag, Bombardment	p*UBI1-cry1Ac-nos*t	Resistance against yellow stem borer larvae
Xiushi 11	Ag	p*UBI-cry1Ab-nos*t	Resistance to striped stem borer
Ewan 5	Bombardment	p*RSS1-GNA-nos*t	Resistance to small brown plant hopper
Basmati-370	Bombardment	p*UBI1-cry1Ab-nos*t, p*BP10-cry1Ab-nos*t, p*PEPC-cry1Ab*-i(*PEPC*)-*35S*t	Organ specific expression and resistance to yellow stem borer and leaf folder
Xiushui 11	Ag	p*UBI1-cry1Ab*- *nos*t	Inheritance and expression patern of *cry1Ab* studied under field conditions
Jarrah	Ag	p*ACT1-RRSV S9*-t	Resistance to rice ragged stunt oryzavirus
Taipei 309	Bombardment	p*RBCS-MOD-nos*t, p*ACT-RCH10*- *nos*t	Tolerance to sheath blight pathogen, *Rhizoctonia solani*
Pusa Basmati 1	Ag	p*UBI-CHI11-nos*t	Protection against sheath blight pathogen, *R. solani*
Cica 8	Bombardment	p*35S-RHBV-N*- *nos*t	Resistance to rice hoja blanca virus
Chaitanya, Phalguna	Ag	p*RSS1-GNA-nos*t	Resistance to brown plant hopper and green leaf hopper
Nipponbare	Ag	p*35S-GNS-nos*t	Resistance to rice blast fungus *Magnaporthe grisea*
Taipei 309	Bombardment	p*35S-RBBI2-3*-t	Resistance to *Magnaporthe grisea*
Pusa Basmati 1	Ag	p*UBI1-i*(*UBI1*)-*CHI11-nos*t	Enhanced resistance to sheath blight pathogen, *Rhizoctonia solani*
Xiushui 11	Ag	p*UBI1-cry1Ab-nos*t	Resistance to rice leaf folder, *Cnaphalocrocis medinalis*, under field conditions
Taipei 309	Bombardment	p*UBI1-GOX*-t, p*PAL-GOX*-t	Resistance to bacterial and fungal pathogens
IR-58, Senia	Bombardment	p*UBI*-i(*UBI*)-*ITRI-nos*t	Protection against coleopteran rice weevil *Sitophilus oryza*

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Basmati 370	Bombardment	p*UBI-cry1Ab-nos*t, p*BP10-cry1Ab-nos*t, p*PEPC-cry1Ab*-i(*PEPC*)*-35S*t	Successful field assessment of transgenic rice
Senia	Ag	p*UBI1-syn-afp-nos*t, p*UBI1-nat-afp-nos*t	Resistance to blast fungus, *Magnaporthe grisea*
Chaitanya, Phalguna, Swarna	Ag	p*UBI1-cry1Ac-nos*t, p*UBI1-cry1Ab-nos*t	Resistance to yellow stem borer and sap-sucking insects
Chaitanya	Ag	p*RSS1-GNA-nos*t	Resistance to white-backed plant hopper
Mudanjiang 8	Ag	*Xa26* genomic fragment	Enhanced resistance to bacterial blight
Kinmaze	Ag	p*UBI1-OSMT2B-nos*t, p*UBI1-OSMT2B-GFP* linker-*OSMT2BAs-nos*t	*OsRAC1* is involved in down regulation of *OsMT2B* expression
Nackdong	Ag	p*UBI-MK1-nos*t	Enhanced tolerance to *Magnaporthe grisea*
Nipponbare	Ag	p*UBI-OSYK1*-t	Prevention against bacterial-induced cell death
Taipei 309	Ag	p*UBI1-TGA2.1(DN)-nos*t, p*UBI1-rTGA2.1(SI)-nos*t	Resistance to *Xanthomonas oryzae* pv. *oryzae*
Taipei 309	Ag	p*UBI-OSNPR1-nos*t, p*UBI*-As*OSNPR1-nos*t	Constitutive expression of defense pathway
Nipponbare, Drew, Zhonghua	Ag	p*35S-OSSERK1- 35S*t, p*35S*-As*OSSERK1-RI-35S*t	Fungal stress tolerance
—	Bombardment	p*UBI1-cry1Ac-RB*-t	Effective against wide range of insects including Bt resistance insects
Zhuxian B	Bombardment	*GNA+SBTI*	Resistance to both *C.medinalis* and *N. lugens*
—	—	p*35S-HLFN/ HLF*	Resistance to bacterial seedling blight disease
Nipponbare	Ag	p*GLB-1-AMYL- AVIDIN-nos*t	Larvae of *Tribolium confusum* and *Sitotoroga cerealella* died when fed on transgenic rice
Minghui63	Ag	p*UBI1-cry2A-nos*t	Resistance against lepidopteran insects
IR-64	Ag	p*35S-ASAL-nos*t	Resistance against sap sucking insects
Senia	Ag	p*UBI1-Ap-cecA-nos*t, p*UBI1*-ER-*cecA-nos*t	Tolerance against Magnoporthe grisea
Nipponbare	Ag	p*35S-OSRACB*-t	Increased susceptibility to blast disease
NBB5	Ag	p*35S-Xa5-nos*t	Resistance to blight disease

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Taipei 309	Bombardment	p*UBI*-i(*UBI*)-*RYMVCP*-*nos*t, p*UBI*-i(*UBI*)-As*CP*-*nos*t, p*UBI*-i(*UBI*)-Δ*NLSCP*-*nos*t, p*UBI*-i(*UBI*)-*mCP*-*nos*t	Moderate resistance to yellow mottle virus
Minghui	Ag	p*35S*-*OSDR8*-*RNAi*-*nos*t	OSDR8 is essential for tolerance against bacterial blight and blast fungus
Taipei 309	Ag	p*35S*-variable *Pi9* genomic fragments-*nos*t	Blast resistance
Nipponbare	Ag	p*35S*-*eIf*(*iso*)*4G*-*nos*t	Resistance to rice yellow mottle virus
Taipei 309	Ag	*Pid2* genomic fragment, p*35S*-*Pid2*-t	Resistance to blast disease
		Abiotic stress	
Nipponbare	Bombardment	p*ACT1*-*HVA1*-*PINII*t	Increased tolerance to drought and salinity
Nipponbare	Ag	p*35S*-i(*SODCC2*)-*codA*-*nos*t, p*35S*-i(*SODCC2*)-TP(*RBCS*)-*codA*-*nos*t	Increased tolerance to salt and cold
Yamahoushi	Ag	p*UBI1*-*GPAT*-*nos*t	Chilling tolerance
Kinuhikari	Electroporation	p*35S*-i(*CAT1*)-TP-*GS2*-*nos*t	Improves salt tolerance
Notohikari	Ag	p*35S*-*OSCDPK7*-*nos*t	Tolerance to cold, salt and drought stress
Taipei 309	Bombardment	p*ACT1*-i(*ACT*)-*PDC*-*nos*t	Submergence tolerance
M12	Bombardment	p*UBI*-i(*UBI*)-*ADC*-*nos*t	Accumulation of putrescine in calli but not in vegetative tissues
TNG67	Ag	*4ABRC1*-*pACT1*-i(*HVA22*)-*ADC*-*PINII*t	Accumulation of polyamines and salt stress tolerance
Tsukinohikari	Ag	Genomic fragment carrying *NAATB* and *NAATA*	Enhanced tolerance to iron deficiency
Yamahoushi	Ag	p*UBI1*-*SGPAT*-*nos*t, p*UBI*-*AGPAT*-*nos*t	Low temperature
EYI105	Bombardment	p*UBI*-i(*UBI*)-*DSAMDC*-*nos*t	High polyamines accumulation
TNG67	Bombardment	p*ACTI*-*PMA80*-*PINII*t, p*ACT*-*PMA1959*-*PINII*t	Enhanced dehydration tolerance
Pusa Basmati 1	Ag	p*35S*- TP(*RBCS*)-*codA*-*nos*t	Tolerance to salt stress
Pusa Basmati 1	Ag	p*ABA*-*TPSP*-*PINII*t, p*RBCS*-TP(*RBCS*)-*TPSP*-*PINII*t	Tolerance to salt, drought and low temperature stress
Sasnishiki	Ag	p*UBI*-*PSL029*-*nos*t	Enhanced germination and growth under low temperature

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Kinuhikari	Electroporation	p*35S*-i(*CAT*)- *AgNHX -nos*t	Enhanced salt tolerance
Pusa Basmati 1	Ag	4*ABRC-pACT1*-i(*HVA22*)-*PINII*t, p*ACT-HVA1-PINII*t	Enhanced growth under salt or drought stress
Norin 8	Ag	*SPL7* genomic fragment	Heat stress tolerance
Zhonghua9	Bombardment	p*35S-TABREB1-nos*t	Reduced plant growth even in unstressed conditions
IR 50	Bombardment	p*UBI*-i(*UBI*)-*P5CS-nos*t	Salt tolerance
Pusa Basmati 1	Ag	p*UBI1-AtHSP101-nos*t	High temperature tolerance
Kinuhikari	Electroporation	p*35S*-i(*CAT*)-*HvPIP2-nos*t	Increased shoot/root ratio and salt sensitivity
Nackdong	Ag	p*UBI-TPSP-PINII*t	Salt and drought tolerance
Nipponbare	Ag	p*35S-OSMAPK5-35S*t, p*35S*-As*OSMAPK5-35S*t	Biotic and abiotic stress tolerance
—	Ag	p*UBI-SAMDC-nos*t	Drought tolerance
Zhonghua	Ag	p*SWAP2-RWC3-nos*t	Enhanced drought avoidance
Kenfong	Bombardment	p*ACT1-P5CS-PINIII*-t, p*AIPC-P5CS-PINIII*-t	Higher biomass accumulation under stress conditions
Dongjin	Ag	*T-DNA* tagged lines	*OsP5CS2* was found essential for salt and cold tolerance
Hishinoyume	Ag	p*35S-sHSP17.7*-t	Protection against heat and UVB stress
Nipponbare	Ag	p*35S-OSNHX1*-t	Enhanced salt tolerance
—	Ag	p*UBI-CBF/DREB1b-nos*t	Overexpression could not enhance cold or drought tolerance
—	Ag	p*35S-OSCDPK13-nos*t	Improved cold tolerance
Nipponbare	Bombardment	p*ACT1-HVA1*-t	Increased drought tolerance via cell membrane protection
Kasalath	Ag	p*ACT1-P5CS-PINII*t	Enhanced UV-tolerance
Zhongzuo	Ag	p*35S-nhaA-nos*t	Enhanced salt and drought tolerance
Zhonghua	Ag	p*SWAP2-TEV*-TP-*MnSOD-35S*t	Drought tolerance
Zhonghua 11	Ag	p*SKC1-SKC1*-t	Salt stress tolerance QTL
Nakdong	Ag	p*UBI1-CBF3-PINII*t p*UBI1-ABF3-PINII*t	Abiotic stress tolerance
Nipponbare	Ag	p*35S-OSPTF-RBCS-E9*t	Phosphate deficiency tolerance
Xiushui	Ag	p*35S-CNATR-nos*t	Salt stress tolerance

Annex-6 Continued…

Genetic enhancement of biotic, abiotic and herbicide stress tolerance in transgenic rice (*Continued*)

Cultivar/Variety	Transformation method	Construct	Comments
Zhonghua-11	Ag	p35S-*SSNHX1-ocs*t	Salt and drought tolerance
Nipponbare	Ag	p35S-*SNAC1*-t	Drought tolerance in lab and field conditions
Nipponbare, Kita-ake	Ag	*OsDREB1A, OsDREB1B, AtDREB1A, AtDREB1B* and *AtDREB1C*	Tolerance to drought, high salt and cold
Liaogeneg	Ag	p*UBI-SUB1A-1*-t	Submergence tolerance
TNG67	Ag	RB7p*AIPC*-TP(*RBCS*)-*COX-PINII*t, RB7p*UBI*-TP(*RBCS*)-*COX-PINII*t	Stress inducible production of glycine betaine resulted in higher salt tolerance
		Herbicide	
Gulfmont, IR54, IR26, IR36, IR72	Bombardment	p35S-*bar-RBCS*t	Resistance to bialaphos up to 500 ppm
Taipei 309	PEG	p35S-*DHFR-nos*t	High level of resistance to methotrexate
IR72	PEG	p35S-*bar-35S*t	Basta herbicide resistance
Gulfmont, IR72	Bombardment	p35S-i(*ADH1*)-*bar-nos*t	Field-level resistance to glufosinate
Nackdong	Ag	p*UBI1-protox-nos*t, p*UBI1*-TS-*protox-nos*t	Resistance to DPE herbicide oxyfluorfen
Nipponbare	Ag	p35S- *CYP2C9/C19-nos*t	Transgenic plants evade sensitivity to herbicides
Nipponbare	PEG, Ag	p35S-*CYP2B6/C9/C18/C19-nos*t, p*E7-AMV-5'*UTR-*CYP1A1-nos*t	Cross-tolerance to several herbicides
Nipponbare	Ag	p35S-*CYP1A1*-t p35S-*CYP2C19*-t p35S-*CYP2B6*-t	Strong cross-tolerance to various herbicides
Notohikari	Ag	p*E35S-cbnA-35S*t	Enhanced degradation of chlorinated compounds
Lemont	Ag	p35S-As*OSGSTIII-GST*t	Reduced detoxification of herbicide pretilachlor and phenolics
Dongjin	Ag	p*UBI-mx-protox-nos*t	Tolerance to herbicide oyfluoren
Nipponbare	Ag	p35S-*CYP2B6-nos*t	Enhanced detoxification of several kinds of herbicides
Nipponbare	Ag	p35S-*CYP1A1-nos*t, p35S-*CYP2B6-nos*t, p35S-*CYP2C19-nos*t	Cross-tolerance to many herbicides
Nipponbare	Ag	p*35SE7-AMV5'UTR-CYP2b22, CYP2C49-nos*t	Broad spectrum tolerance towards herbicides
Nipponbare	Ag	p*35S-AMV5'UTR-CYP2B6, CYP1A1, CYP2C19-nos*t	Enhanced tolerance towards many herbicides

NOTE[114]: *Electroporation*=Enhanced electrical field for increasing permeability to ease DNA/gene transfer*,* *Bombardment*=Micro projectile bombardment or biolistics, Ag=*Agrobacterium* mediated gene transfer, *PEG*=Poly ethylene glycol mediated gene transfer

ANNEX-A

FEEDBACK FROM BASMATI RICE MANUFACTURING INDUSTRY-AIREA

1. COMPANY NAME: BEST FOODS LTD., KARNAL

ALL INDIA RICE EXPORTERS' ASSOCIATION

81/2, Adchini, Sri Aurobindo Marg, New Delhi – 110 017.
Phone: +91 - 11 - 41071555 Fax: +91 - 11 - 41070555
Email: airea.delhi@gmail.com Website: www.airea.net

QUESTIONNAIRE ON MAINTAINING IDENTIFICATION OF BASMATI RICE BY PROCESSING INDUSTRY

1. **Name of Processing Industry:** ____Best Foods Ltd.____
   Address: __Village – Norta, Tehsil – Indri, District – Karnal, Haryana, India_______
   Telephone and E-mail ID: __0184 4092700, M. 97298 70009, mpjindal@bestfoodgroup.com, bestfoodgroup@gmail.com____

2. Annual processing capacity of your unit: 7,50,000 M.T. (Rice)
   - Domestic: 60,000 M.T. (Aprox)
   - Exports: 1,00,000 M.T. Approx)

3. Countries where you export: Sheet attached

4. What are the identity preservation indicators used by you in procuring and processing basmati rice
   - Size: Length Of Brown Rice in between 6.80 m.m to 7.65 m.m.
   - Aroma: Natural Aroma of Basmati
   - Varietal identification: Long Cylindrical
   - Any other ______________________________

5. Methodology followed for confirmation of identity of the basmati rice (Please tick):
   - ☐ Visual √
   - ☐ Measurement of length of Grains
   - ☐ Test for aroma
   - ☐ DNA fingerprinting √
   - ☐ Any other method (if applicable) ______________________
   (Please specify and elaborate if you carry out any nucleic acid testing method/procedure with brief outline of the process):______________________
   ____

Date____________ **Authorized Signatory of the Company**

BEST FOODS LIMITED * INDRI *

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ANNEX-A Continued…

Name of Country

Sr.no.		Sr.no.		Sr.no.		Sr.no.	
1	Australia	16	Fiji	31	Nepal	46	Sweden
2	Angola	17	Georgia	32	New Zealand	47	Somalia
3	Armenia	18	Germany	33	Libya	48	Switzerland
4	Azerbaijan	19	Guadeloupe	34	Oman	49	Tajikistan
5	Bahrain	20	IRAN	35	Poland	50	Tanzania
6	Brazil	21	IRAQ	36	Malaysia	51	Trukey
7	Botswana	22	Italy	37	Maldives	52	Turkmenistan
8	Canada	23	Kenya	38	Reunion Island	53	UAE
9	Congo	24	Kuwait	39	Russia	54	UK
10	Combodia	25	Jordan	40	Saudi Arabia	55	USA
11	Cyprus	26	Kyrgyzstan	41	Seychelles	56	Ukraine
12	Egypt	27	Israel	42	Singapore		
13	Ethiopia	28	Lebanon	43	Qatar		
14	Djibouti	29	Mauritius	44	Russia		
15	France	30	Netherlands	45	South Africa		

Date 12/4/16

Authorized Signatory of the Company

BEST FOODS LIMITED

ANNEX-A Continued…

6. What are the steps where verification of basmati rice is undertaken? Please tick the steps listed below and provide relevant details about the parameters and procedures followed:

□Contact with the producer/farmer:______________________________________

□Verifyingthe identity of the planting paddy materials: _______________________

□Inspection of fields(Please specify any additional steps taken by the farmers to ensure identity preservation): ____

√□ **Procuring Basmati rice at mandi:**______________________________________

□ Transportation from farmers' field to mandi and to the processing unit: _____________

□ Storagein processing unit: ____

□ Processing operations: ____

□ Packaging and labeling of the final product: ___________________________________

7. Do you have SOPs for various steps including transportation and storage?If so, please provide the details: **No**

8. Do you engage any third party agencies for documentation/ testing of basmati rice? (If yes, please provide the details): **Various testing labs such as SPS, TUV, Modi etc**

9. Do you sell basmati rice with varietal details or any other key identifiers on the label?:

   No, not required, we mentioned when exporting Pusa Basmati 1121

10. Estimated costs in verification and checking of basmati rice at various steps viz: procurement, mandi, entry into premises, testing etc.: **Rs.100/ton**

11. Who bears the cost of Identity Preservation, when carried out? Is there any sharing of such costs between the buyers and your company?: **Company. No there is no sharing of cost between buyer and our company.**

12. Any other views you would like to share regarding identity preservation of Basmati Rice?: **It is solely the responsibility of the processing company**.

ANNEX-A Continued…

2. COMPANY NAME: KOHINOOR FOODS LTD., FARIDABAD

ALL INDIA RICE EXPORTERS' ASSOCIATION

81/2, Adchini, Sri Aurobindo Marg, New Delhi – 110 017.
Phone : +91 – 11 - 41071555 Fax : +91 – 11 – 41070555
Email : airea.delhi@gmail.com Website : www.airea.net

QUESTIONNAIRE ON MAINTAINING IDENTIFICATION OF BASMATI RICE BY PROCESSING INDUSTRY

1. **Name of Processing Industry:** Kohinoor Foods Ltd.

   Address: Pinnacle Business Tower, 10th Floor,Surajkund, Faridabad - 121001

   Telephone and E-mail ID: 91-129-4242222, info@kohinoorfoods.in

2. **Basmati Paddy procurement trend for last 3 years**

Basmati Variety	*Names of the varieties and their procurement quantities year-wise for 3 years						
	Year	**Variety # 1**	**Variety # 2**	**Variety # 3**	**Variety # 4**	**Variety #5**	**TOTAL**
	2014						
	2015						
	2016						

*Not disclosed

3. Annual processing capacity of your unit: 350000 MT
   - Domestic:
   - Exports: 115000 MT

4. Countries where you export: EU, US, Saudi Arabia, Australia , New Zealand, African Countries, UAE etc approx 65 countries

5. What are the identity preservation indicators used by you in procuring and processing basmati rice

   - **Size:** Experienced Trade experts deputed for purchase of paddy, During processing length of the rice to be more than 6.6 mm
   - **Aroma:** Good storage practices followed to store the product at safe moisture < 14% and Sensory evaluation done while processing to ensure aroma strong to mild

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ANNEX-A Continued…

- **Varietal identification:** Experienced Trade experts deployed to ascertain varietal purity by morphological characteristics eg. Shape & Size of the grain, which is randomly verified by DNA analysis for purity
- **Any other :** Random GMO Analysis for Non-GMO status and In case EU export " Certificate of Authenticity" taken from " Export Inspection Agency ".

6. Specific requirements of Importing Countries, if any: **Meeting their quality standards with regard to pesticides MRL**

7. Methodology followed for confirmation of identity of the basmati rice (Please tick):
   - ✓ □ Visual (Shape & Size and appearance)
   - ✓ □ Measurement of length of Grains and L/B Ratio
   - ✓ □ Test for aroma (Sensory Evaluation)
   - ✓ □ DNA fingerprinting (Random basis)
   - ✓ □ Any other method (if applicable) (Certificate of Authenticity from EIA)

   (Please specify and elaborate if you carry out any nucleic acid testing method/procedure with brief outline of the process):

8. What are the steps where verification of basmati rice is undertaken? Please tick the steps listed below and provide relevant details about the parameters and procedures followed:

   □Contact with the producer/farmer: ____________________

   □Verifyingthe identity of the planting paddy materials: ____________

   □Inspection of fields(Please specify any additional steps taken by the farmers to ensure identity preservation): ____________________

   √□ **Procuring Basmati rice at mandi:** ____________________

   □ Transportation from farmers' field to mandi and to the processing unit: ________

   □ Storagein processing unit: ____________________

   □ Processing operations: ____________________

   □ Packaging and labeling of the final product: ____________________

9. Do you have SOPs for various steps including transportation and storage?If so, please provide the details: **No**

10. Do you engage any third party agencies for documentation/ testing of basmati rice? (If yes, please provide the details): **Various testing labs such as SPS, TUV, Modi etc**

11. Do you sell basmati rice with varietal details or any other key identifiers on the label?:

    No, not required, we mentioned when exporting Pusa Basmati 1121

12. Estimated costs in verification and checking of basmati rice at various steps viz: procurement, mandi, entry into premises, testing etc.: **Rs.100/ton**

ANNEX-A Continued…

13. Who bears the cost of Identity Preservation, when carried out? Is there any sharing of such costs between the buyers and your company?: **Company. No there is no sharing of cost between buyer and our company.**

14. Any other views you would like to share regarding identity preservation of Basmati Rice?: **It is solely the responsibility of the processing company**.

Date_______________ **Authorized Signatory of the Company**

ANNEX-A Continued…

3. COMPANY NAME: EBRO INDIA (P) LTD., KARNAL

ALL INDIA RICE EXPORTERS' ASSOCIATION

81/2, Adchini, Sri Aurobindo Marg, New Delhi - 110 017.
Phone: +91-11-41071555 Fax: +91-11-41070555
Email: airea.delhi@gmail.com Website: www.airea.net

QUESTIONNAIRE ON MAINTAINING IDENTIFICATION OF BASMATI RICEBY PROCESSING INDUSTRY

1. **Name of Processing Industry:** Ebro India (P) Ltd.
   Address: Vill. Takhana, G.T Road, Taraori, Karnal
   Telephone and E-mail ID: 01745-242249
2. **Basmati Paddy procurement trend for last 3 years**

Basmati Variety	***Names of the varieties and their procurement quantities year-wise for 3 years**						
	Year	**Variety # 1**	**Variety # 2**	**Variety # 3**	**Variety # 4**	**Variety #5**	**TOTAL**
	2014						
	2015						
	2016						

*Not disclosed

3. Annual processing capacity of your unit: Approx. 1,00,000 MTs
   - Domestic: Roughly 50%; depends on demand
   - Exports: Roughly 50%; depends on demand
4. Countries where you export: EU, North America, Saudi Arabia, UAE & Iran
5. Specific requirements of Importing Countries, if any: **Meeting their quality standards with regard to pesticides MRL**
6. What are the identity preservation indicators used by you in procuring and processing basmati rice
   - Size: ____
   - Aroma: ____
   - Varietal identification: Varietal Identification. As long as variety is pure rest everything is taken care of.
   - Any other ____

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ANNEX-A Continued…

7. Methodology followed for confirmation of identity of the basmati rice (Please tick):
   - □ Visual **Yes**
   - □ Measurement of length of Grains **Yes**
   - □ Test for aroma **Yes, if & when needed.**
   - □ DNA fingerprinting **Yes, as and when needed**
   - □ Any other method (if applicable) ______________________

   (Please specify and elaborate if you carry out any nucleic acid testing method/procedure with brief outline of the process):______________________
   ____

8. What are the steps where verification of basmati rice is undertaken? Please tick the steps listed below and provide relevant details about the parameters and procedures followed:
   - □Contact with the producer/farmer:______________________
   - □Verifyingthe identity of the planting paddy materials: ______________________
   - □Inspection of fields(Please specify any additional steps taken by the farmers to ensure identity preservation): ______________________
   - √□ **Procuring Basmati rice at mandi:**______________________
   - □ Transportation from farmers' field to mandi and to the processing unit: ____________
   - □ Storage in processing unit: ______________________
   - □ Processing operations: ______________________
   - □ Packaging and labeling of the final product: ______________________

9. Do you have SOPs for various steps including transportation and storage?If so, please provide the details: **No**

10. Do you engage any third party agencies for documentation/ testing of basmati rice? (If yes, please provide the details): **Various testing labs such as SPS, TUV, Modi etc**

11. Do you sell basmati rice with varietal details or any other key identifiers on the label?:

    No, not required, we mentioned when exporting Pusa Basmati 1121

12. Estimated costs in verification and checking of basmati rice at various steps viz: procurement, mandi, entry into premises, testing etc.: **Rs.100/ton**

13. Who bears the cost of Identity Preservation, when carried out? Is there any sharing of such costs between the buyers and your company?: **Company. No there is no sharing of cost between buyer and our company.**

14. Any other views you would like to share regarding identity preservation of Basmati Rice?: **It is solely the responsibility of the processing company**.

Date: 12-April-17 **Authorized Signatory of the Company**

ANNEX-A Continued…

4. COMPANY NAME: SSA INTERNATIONAL LIMITED, PANIPAT

ALL INDIA RICE EXPORTERS' ASSOCIATION

81/2, Adchini, Sri Aurobindo Marg, New Delhi - 110 017.
Phone: +91-11-41071555 Fax: +91-11-41070555
Email: airea.delhi@gmail.com Website: www.airea.net

QUESTIONNAIRE ON MAINTAINING IDENTIFICATION OF BASMATI RICE BY PROCESSING INDUSTRY

1. **Name of Processing Industry:** SSA International Limited
   Address: 67th Milestone Village Bhodwal, Samalkha, Panipat, Haryana
   Telephone and E-mail ID: 91-11-41258950, monika@ssa-international.com
2. Annual processing capacity of your unit: 2.5 lac Tonnes Per Year
   - Domestic: 50% of Annual T.Over
   - Exports: 50% of Annual T. Over
3. Countries where you export: Europe, UAE, USA, Saudi Arabia, Yemen, Kuwait, Iraq etc.
4. What are the identity preservation indicators used by you in procuring and processing basmati rice
   - Size: ✓ Depending upon Basmati Rice Varieties
   - Aroma: ✓
   - Varietal identification: ✓
   - Any other Color
5. Methodology followed for confirmation of identity of the basmati rice (Please tick):
   - ☑ Visual
   - ☑ Measurement of length of Grains
   - ☑ Test for aroma
   - □ DNA fingerprinting
   - □ Any other method (if applicable)
   (Please specify and elaborate if you carry out any nucleic acid testing method/procedure with brief outline of the process):

Date 12/4/17 **Authorized Signatory of the Company**

SSA INTERNATIONAL LIMITED DELHI

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ANNEX-A Continued…

6. What are the steps where verification of basmati rice is undertaken? Please tick the steps listed below and provide relevant details about the parameters and procedures followed:

□Contact with the producer/farmer:______________________________

□Verifyingthe identity of the planting paddy materials: ____________________

□Inspection of fields(Please specify any additional steps taken by the farmers to ensure identity preservation): ______________________________

√□ Procuring Basmati rice at mandi:______________________________

□ Transportation from farmers' field to mandi and to the processing unit: ____________

□ Storagein processing unit: ____________________________________

□ Processing operations: ____________________________________

□ Packaging and labeling of the final product: __________________________

7. Do you have SOPs for various steps including transportation and storage?If so, please provide the details: **No**

8. Do you engage any third party agencies for documentation/ testing of basmati rice? (If yes, please provide the details): **Various testing labs such as SPS, TUV, Modi etc**

9. Do you sell basmati rice with varietal details or any other key identifiers on the label?:

   No, not required, we mentioned when exporting Pusa Basmati 1121

10. Estimated costs in verification and checking of basmati rice at various steps viz: procurement, mandi, entry into premises, testing etc.: **Rs.100/ton**
11. Who bears the cost of Identity Preservation, when carried out? Is there any sharing of such costs between the buyers and your company?: **Company. No there is no sharing of cost between buyer and our company.**

12. Any other views you would like to share regarding identity preservation of Basmati Rice?: **It is solely the responsibility of the processing company**.

ANNEXURE-B

COLLATED INFORMATION SUBMITTED BY FOUR BASMATI RICE PROCESSING UNITS

Name of Processing Industry with Location	BEST Foods Ltd., Karnal	Kohinoor Foods Ltd., Faridabad	ERBO India (P) Ltd., Karnal	SSA Intl. Ltd., Panipat	Remarks
Variety-wise Basmati Paddy procurement trend	Not Disclosed	Not Disclosed	Not Disclosed	Not Disclosed	Procurement is made from Mandi. Variety-wise segregation seems to be non-feasible from Mandi
Annual Processing Capacity	7,50,000 MT (Rice) 60,000 MT Basmati DOM[*] 1,00,000 MT Basmati EXP[*]	3,50,000 MT 1,15,000 MT Basmati EXP	1,00,000 MT 50% DOM 50% EXP	2,50,000 MT 50% DOM 50% EXP	Domestic & Export market capacity utilization depends upon demand
Names of Countries Exported To	Exported to 56 countries incl. EU[**], US[***] & Middle-East[#]	Exported to 65 countries incl. EU, US & Middle-East	Exported to EU, US, Saudi Arabia, UAE[##], Iran	Exported to EU, US & Middle-East	Indian exports are to a wide range of countries which include EU, US, Middle-East, CIS[@] and South America
Specific requirement of Importing countries	Visual (Shape, Size & Appearance of grain) and DNA fingerprinting	Visual (Shape, Size & Appearance of grain and L/B ratio), DNA fingerprinting and Certificate of Authenticity from EIC[###]	Visual (Size, Shape and Appearance). Meeting quality standards with regard to Maximum Residue Limits (MRL), DNA fingerprinting when needed	Visual (Shape, Size, Appearance of grain color), Aroma	Molecular testing methods are carried out only when there is a demand from the importing countries. Not all companies carry out such tests for exports in regions not requiring such testing procedures.
Identity Preservation (IP) indicators used by Company during procurement	Size, Aroma, and Varietal Identification by visual methods and measurements. Procurements from Mandi	Size (Grain size after processing>6.6 mm in length), Aroma and Varietal Identification by morphological characteristics. Randomly verified by DNA analysis for varietal identification. Procurements from Mandi	Size, Aroma and Varietal Identification by visual methods and measurements. DNA fingerprinting carried out as and when needed. Procurement from Mandi.	Size, Aroma, Varietal Identification and Color measurement by visual methods and measurements. Procurement from Mandi.	IP indicators are presently the measurement of size, shape and measurement of length of grains. Consignments are also graded on color. DNA fingerprinting analysis done when required but is not a normal practice for varietal identification. Procurement is from Mandi.
Steps taken for verification during procurement	Same as above	Same as above	Same as above	Same as above	-
Methodology Followed for confirmation of IP	Same as above	Same as above	Same as above	Same as above	-

ANNEX-B Continued…

Standard Operating procedures (SOPs), if any, being followed at various steps incl. transportation and storage	No SOP for procurement as well as transportation has yet been made	No SOP for procurement as well as transportation has yet been made	No SOP for procurement as well as transportation has yet been made	No SOP for procurement as well as transportation has yet been made	Every company uses its own methods during procurement, transportation and trading
Engagement of third party for documentation testing	Various testing laboratories such as SPS, TUV, Modi etc. are contacted for testing services when required	Various testing laboratories such as SPS, TUV, Modi etc. are contacted for testing services when required	Various testing laboratories such as SPS, TUV, Modi etc. are contacted for testing services when required	Various testing laboratories such as SPS, TUV, Modi etc. are contacted for testing services when required	Third party documentation is carried out by contacting various testing laboratories in the country who provide the services and certification
Is sale/export of Basmati made with any key identifier on the label?	No. According to the company, this is not required. They mention Pusa Basmati 1121 when this variety is expected	No. According to the company, this is not required. They mention Pusa Basmati 1121 when this variety is expected	No. According to the company, this is not required. They mention Pusa Basmati 1121 when this variety is expected	No. According to the company, this is not required. They mention Pusa Basmati 1121 when this variety is expected	It appears that while exporting Basmati rice, the name of the declaration of the name of the variety
Total estimated cost in verification and checking of Basmati rice at various steps	Mentioned to be Rs 100/ton of rice	Mentioned to be Rs 100/ton of rice	Mentioned to be Rs 100/ton of rice	Mentioned to be Rs 100/ton of rice	The testing cost mentioned is very small, nearly 0.2%, present prevailing cost of Basmati rice
Who bears the cost of IP?	The cost of testing is borne by the company	The cost of testing is borne by the company	The cost of testing is borne by the company	The cost of testing is borne by the company	The testing cost is not shared by any of these companies at any stage. They bear the costs themselves

***DOM=Domestic, *EXP=Exports, **EU=European Union, ***US=United States, #Middle-east=Iran, Iraq, Saudi Arabia, Qatar etc., ##UAE=United Arab Emirates, @CIS=Commonwealth of Independent States, ###EIC=Export Inspection Council of India**