CAN GM AND NON – GM CROPS BE SEGREGATED IN INDIA – IS COEXISTENCE POSSIBLE?

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Before countries can begin to consider coexistence of GM and non GM crops, they need to put in place a number of policies and laws to regulate aspects like labeling, trace ability, liability & redress.

Coexistence of GM and non-GM crops is being promoted as a way to resolve the conflict over genetically modified crops and create space for both in the same agricultural system. This approach has gained support after the EU- US dispute in the WTO over the EU's de facto moratorium on the import of GM foods. Recent studies conducted in the US assert that coexistence is possible and that most organic farmers have neither incurred extra costs nor suffered any disadvantages due to the cultivation of GM crops in their vicinity.

The projection of coexistence as a feasible agricultural model is a source of anxiety for developing countries like India. Since the subject of GM crops is already internationalized through the Bio-Safety Protocol of the Convention on Biological Diversity, concepts like Coexistence, Labelling, Identity Preservation and traceability could become international policies that developing countries are compelled to implement. Would such an implementation be possible? Do developing countries have the capacity to segregate GM crops from non – GM crops, preserve the individual identity of each category, introduce mechanisms to trace food backwards from the store to the farm, and introduce meaningful labelling? In short, is coexistence of GM and non – GM crops feasible in the agricultural conditions prevailing in developing countries?

Co-existence in Agriculture

The broad notion of coexistence is based on the laws of most of the countries in the world, according to which farmers must be able to choose the crops they wish to cultivate, whether they are GM, organic or conventional crops. Co-existence deals with the possibility of different kinds of crops being cultivated and coexisting in the same agricultural system. Since different kinds of crops carry differing price premiums, it is natural that one of the important aspects of coexistence is the economic consequence of adventitious presence of material from one crop in another crop.

Accidental or adventitious presence can arise for a variety of reasons. These can include seed impurities, cross pollination, volunteers (plants that come up from seed left over from a previous crop), as well as from seed left inside planting equipment at the time of harvesting, and during storage and transport.

With respect to GM crops the foremost concern remains the economic consequences of adventitious presence of GM crops in non-GM crops and the presence of GM or conventional crop material in consignments of organic harvests.

<u>Co-existence in conventional agriculture in industrialized countries</u>

The practice of coexistence developed in the agriculture of industrialized countries for the purpose of differentiating high value crops from ordinary crops. Its history is older than that of the GM- non-GM segregation issue.

Trade in agricultural commodities assumes that some degree of adventitious presence of unwanted material will be found in supplies, so the presence of unwanted material from one crop in another crop is accepted in the agricultural sector to a certain extent. In the industrialised countries, the majority of agricultural products are subject to some form of grading, with a smaller percentage subject to a more complex form of identify preservation (IP). In the case of both, tolerance limits are invariably set for the presence of unwanted material because in any food processing/handling chain, ensuring absolute purity of products is virtually impossible. There are several instances where coexistence is practiced in conventional agriculture. Some examples are:

a) **Maintaining different purity levels during certified seed production that will result in different standards of seed.** Here tolerance levels are set for the presence of seed that is not considered ‘pure’. Purity is sought to be maintained by specified separation distances and temporal isolation between the seed crop that is grown for seed and other crops of the same species that are to be used as food. This is also backed up by seed inspection and testing. If the purity standard is not met, the seed will not be certified and the grower will lose the premium available for growing seed rather than grain. However, it has been found that in more than 95% of the cases, compliance with standards and procedures like isolation, cleaning, rotations, and separation of harvest is sufficient as to meet the stringent purity standards required by certified seed production systems.

b) **Cultivating crops for specific traits, like high oil maize or high erucic acid oilseed rape.** Although high erucic acid oilseed rape has anti nutritional properties, it possesses desirable properties for industrial use. It is therefore important that this oil seed rape does not contaminate the low or zero erucic acid seed rape grown for use in human food and animal feed. High erucic acid oilseed rape crops are normally grown on contract to processors. The contracts recognize that there may be adventitious presence of non-erucic oilseed rape in deliveries and specify tolerance limits for its presence. The contracts require that only certified seed is used, seed drills have been cleaned, specified separation distances are maintained from other oilseed rape crops, all cultivation and harvesting equipment is cleaned before use and post harvest segregation is maintained to minimise admixture. Purity is maintained by adequate testing and by attaching penalties, including rejection of crops, if the set parameters for the oilseed fatty acid content are not met. The threshold for admixture of oilseed rape is 2 %. Maintaining sufficient isolation distance can satisfy this condition.

c) **Another area where tolerance limits are set is organic production systems.** Limits are set for the presence of non-organic material in processed foods derived from organic ingredients and which are labeled as such. Limits are also set for the adventitious presence of non-organic material used as agricultural inputs such as for seed and for use as animal feed. Labelling produce as organic is normally based on the adherence to organic production and husbandry principles rather than on any testing regime for the produce, such as identifying the percentage of unwanted material such as pesticide resides.

Co-existence in the case of GM crops

Labelling of GM products, segregating them and setting limits for adventitious presence of GM in non-GM foods, became necessary because of widespread rejection of GM foods by consumers. This led to the development of distinct markets for non-GM products.

In order to respect consumer choice, it became important to segregate and identity preserve (IP) non-GM crops and foods and to label these products throughout the food supply chain. In principle this kind of segregation does not require any radical change in trading practices that have been used to segregate and label specific types of conventional, agricultural produce. However, given the nature of the specific issues surrounding the GM versus non-GM debate there are, indeed, certain differences, and those wishing to avoid GM products have specific demands from the food chain which include:

Non-GM foods must be free of products containing GMOs and products derived from GMOs even if it is not possible to detect GM material in the end product. This requires identity preservation and labelling on a production process basis although in some cases (eg, oil) it is not possible to detect the presence of DNA or protein originating from the GM crops.

There should be no detectable presence of GM material (ie, zero tolerance in the non-GM food.) This aspect is different from the existing practice whereby some level of admixture is accepted.

Even in organic agriculture, there is a certain limited tolerance for the presence of some non-organic ingredients in processed products (5%) and for non-organic inputs (eg, conventional seed). The *de facto* tolerance for the presence of GMOs in organic produce is 0.1%, which is the limit of reliable detection [1]. Non-GM producers, especially those in the organic sector, face the possibility of economic loss if the adventitious presence of GM material in the organic crops is above the stipulated

[1] The commission's March 2003 communication on Co-existence of GM, conventional and organic crops acknowledges that the EU regulation on organic farming (Reg 2092/92) allows for the setting of such a threshold for the adventitious presence of GMOs in organic produce although to date no level has been set.

threshold. In such cases, the farmer stands to lose the price premium as well as incur additional costs on –farm to minimize the risks of adventitious presence of GM.

With respect to contamination with GM material in non-GM crops, the question arises as to who should pay the additional cost. Logically it should be the source of the 'contamination', following the 'polluter' pays principle. In addition to the costs arising from coexistence and contaminants, there are other costs with respect to liability. Costs incurred because of the regulations, laws, guidelines and standards set by government or industry can also affect the total cost. These guidelines usually set minimum standards for the acceptable practice. Government guidelines usually relate to health and safety issues but also extend to issues such as competition and equity. Complying with such regulations imposes costs on producers, and failure to comply with them may even result in criminal or civil legal action and market losses.

In the case of GM crops, the establishment of a regulatory system-based compliance mechanism relating to farm practices needs to be taken into consideration when doing a cost-benefit analysis. This could entail evaluating the benefits of possible yield gains and reduced costs of production against costs like seed premium, and compliance mechanisms. The higher the compliance costs, the lower would be the incentive to adopt the technology and vice versa. This kind of evaluation is not unique to GM technology. It applies to other forms of agriculture also, such as organic agriculture where farmers who are considering switching to the organic production system will weigh the costs of conversion (eg, impact on yields, costs of production, compliance with organic standards/ principles) relative to the benefits of possible higher price premia.

<u>The Cost of Coexistence</u>

By and large the cost of preserving the identity of a product is borne by the sector that produces that product and which will benefit from its production. The producers of high quality regional produce, organic produce, special trait crops like high erucic acid oilseed rape, high oil maize, malting barley, bread making quality wheat, basmati rice etc., would bear the cost of segregation. In all these cases, the respective products would trade at a premium and this premium provides the incentive to preserve integrity and identity.

With respect to GM crops the practice of coexistence would require a stringent system of segregation and identity preservation. This would include a provision for imposing liability on GM crop growers for possible impact on non-GM growers resulting from admixture above a given threshold, which would thereby lead to loss of the 'GM-free' label. This will add to the cost of cultivation. Cultivation costs will escalate because GM farmers would have to take out insurance cover, if such premium insurance were available.

Coexistence agriculture will entail setting tolerance thresholds for the adventitious presence of GM material in non-GM crops. This will have economic implications at the farm level. It will mean additional costs that would be incurred because of having to change farming practices and initiating on farm mechanisms for segregation of GM and non-GM crops. This will also include the economic consequences of not meeting tolerance thresholds. For the cultivation of GM crops, their costs would include covering the cost of contamination of organic or 'GM free' produce. This is difficult to imagine in the absence of an insurance system. At the moment insurance companies are not enthusiastic about offering insurance cover in this sector because of the high probability of contamination of non-GM crops with GM materials.

The essence of coexistence is managing the economic consequences of the unintended presence of one type of crop in another, so that farmers can exercise the choice of cultivation exactly the kind of crops they want, be it organic crops, GE crops or crops carrying high value traits.

The unintended or adventitious presence of an un wanted crop could arise due to many reasons, and at every stage of agricultural operations. These could include cross pollination, volunteer plants, seed impurity, mixed crop residues in farm equipment, during harvesting, transportation and storage of farm produce and afterwards during cleaning processing.

What is Identity Preservation?

Central to coexistence is the notion of stringent segregation and identity preservation. Identity preservation (IP) is a process or system of maintaining the segregation and documenting the identity of a product. An IP system is a strict production and delivery method, which possesses procedures of an effective internal segregation system, that includes observing, inspecting, sampling, and testing to assure the presence (or absence) of certain traits. Identity preserved refers to a crop product that has identifiable characteristics that have been maintained from the seed planted to produce the crop through all the steps of production and transportation up to the end user.

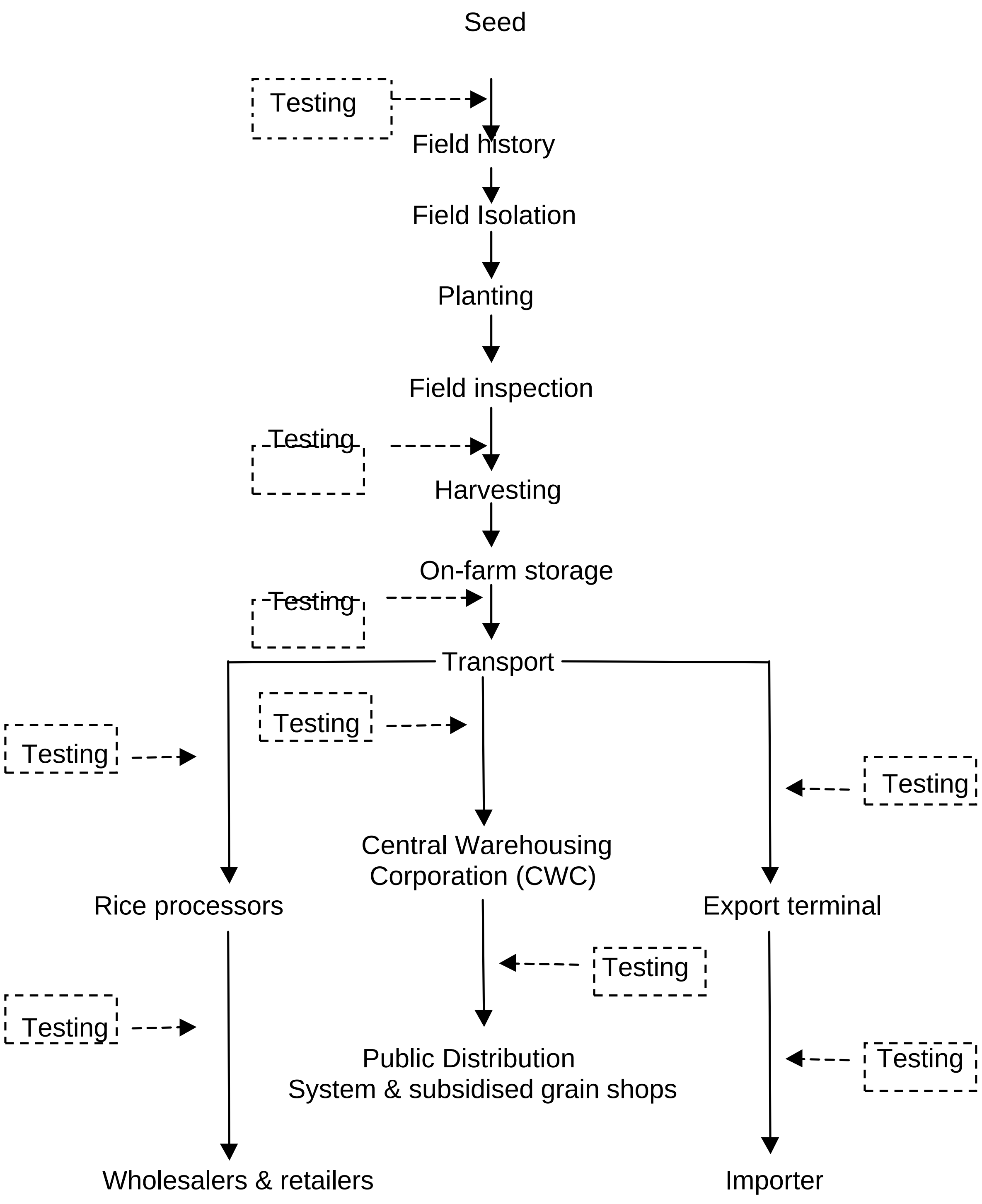
Growers must follow strict growing and handling practices, including segregation, inspections, and cleaning of equipment to prevent other varieties from mixing with or contaminating the IP variety. Other parties that handle, transport, condition, or process the IP product must also maintain and document a similar segregation system. The key to an IP system is traceability. Each production, processing, and delivery step is documented, so that products can be traced from the store shelf back to the farmers' fields and every stage in between. Identity preservation (IP) is a process by which a crop is grown, handled, conditioned, processed, and delivered under controlled conditions, whereby the end user of the product is assured that it has maintained its unique identity from the seed planted to the product delivered to the end user. In common use the process or system of "identity preservation" would result in an "identity-preserved" product. Testing crop samples as a stand-alone procedure does *not* qualify as an identity-preservation system. Identity preservation must include a system of verified steps following the crop through the entire production and delivery system.

Value-enhanced products

With specific value –enhanced traits it is important to maintain those traits from the grower to the end user manufacturer and ultimately the consumer. An identity-preservation system facilitates the segregation of consignments of grains or oilseeds that are distinguishable, by some morphological, physiological or other characteristic, from other consignments. The current emphasis is centered on the genetically modified organism (GMO) issue but the long-term opportunities in identity-preserved products will develop from specialty grain and oilseed traits, whether perfected through conventional or through transgenic breeding methods. Identity preservation today applies principally to three kinds of agricultural commodities. The first is crop varieties that have unique traits. For instance, this could be the iron-fortified rice that is in the pipeline, or it could be oil crops with a different kind of oil profile like high-oil corn, modified sunflower and canola. This therefore is one kind of agricultural produce that is being brought out, as a higher-value product, and identity preservation would be needed to capture this added value and not allow it to get contaminated by ordinary sunflower oil or ordinary canola oil. The second category of agricultural produce that would need its identity to be preserved is organic produce. Organic crops have to follow a rigorous procedure in order to get certification, and they have to be kept strictly segregated in order to receive the premium prices that pure organic food commands. If there is contamination with non-organic or transgenic crops, then the organic status would be compromised. And if the expensive means of dealing with organic production do not lead to premium prices, the farmer suffers a loss. The third and most significant kind of crop produce is GM crops. These are the most controversial crop varieties today in western markets and increasingly so in markets across the rest of the world. The consumer right to have the choice not to eat GM food has led to the demand for clearly implemented segregation mechanisms followed by labelling. Along with this coincides a strong need for identity preservation in agricultural production so that GM crops can be segregated. Two different channels of food production and processing must be maintained, which should not get mixed. The purpose is essentially to ensure that non – GM crops are not contaminated with GM crop varieties.

The cultivation of GM crops started in India with the introduction of Bt cotton. Several kinds of transgenic crop varieties including rice, cauliflower, cabbage, brinjal, muskmelon, papaya and groundnuts are in the pipeline. India has taken a position in the Codex Alimentarius that it will introduce labelling for GM food since its Consumer Protection Act grants consumers the right to choose the food they wish to eat. So the question is whether segregation of GM and non – GM crops is possible and whether identity preservation and traceability can be maintained under Indian agricultural conditions. Would the consumer continue to have the right to choose between GM and non – GM foods? And is it possible to keep GM and non – GM crop varieties segregated so that no compromise of organic produce takes place?

Figure 1: **Steps Needed for Identity Preservation**



[*Adopted from : Sundstrom, F.J., Williams, J., Deynez, A.V. and Bradford, K.J, Identity Preservation of Agricultural Commodities, Agricultural Biotechnology in California Series, University of California, Publication 8077*]

An identity preservation system or an IP system is a well-worked out, standardized system. It has a specific protocol to be adhered to, and it starts right at the source, which is the seed. The seed is to be certified since, in principle, the IP system is a system according to which certain standards have to be maintained, and accurate and detailed records have to be kept, which have to be audited from time to time. This has to be done through the entire crop production cycle from the sowing of the crop to its harvesting, processing, handling and marketing.

The first prerequisite of the IP system is certified seed of great purity. This can only be ensured in a system of agriculture where the certified seed is made freshly available to farmers for each round of cultivation, that is, for the planting of every new crop cycle. That will be impossible to implement in India. The majority of the farmers in India save seed out of their harvest for sowing the next crop, even with high-yielding varieties, where the seed has undergone a certification process starting from the breeders' seed to the foundation seed to the registered seed, which is sold to the farmers. Once the seed reaches the farmers, however, it is multiplied and handled indiscriminately by the farmers. There seems to be a misunderstanding that farmer to farmer sales are relevant only as far as traditional varieties are concerned but that is not true. Once certified seeds of high-yielding varieties have been sold to farmers, subsequent generations of seed are produced by the farmers and sold to each other in large parts of the country. In fact, according to some estimates, up to 85% of the seed requirement of Indian agriculture is met by farmer-to-farmer sales. So the first question mark that would arise in the implementation of an IP system is purity of the seed. Given the kind of agriculture that India practices, the seed would not be pure in the manner required by the IP system. Additionally, an IP system would impose intolerable financial burdens, especially on the small farmers, who would not be able to incur the cost of having to buy fresh seed for every crop cycle. The vulnerability of the small farmers is the reason why India did not accept the patent system in the WTO/TRIPS, as the patent system would allow the patent holding company to force the sale of seed for every new planting. What India selected instead was a sui generis system. It has created a law with a strong farmers' rights component that allows the farmer to continue with the practice of farmer-to-farmer sale of seed.

The next stage of the IP system addresses the kind of field preparation that is required for cultivation. In order to qualify for an IP system, the fields have to be prepared in a specific way. Such fields must not have grown a crop the previous year, as that could produce a contamination, either through weeds or through volunteer plants of the last crop. In fact, the IP system would dictate in certain cases that multiple year rotations would have to be done between crops in order to achieve low to negligible contamination levels. This procedure seems impossible to implement in agricultural conditions in India where weeds are not destroyed but used in other ways by rural communities – for example, as fodder or as medicinal plants. Crop rotation in the Indian agricultural system can hardly be enforced in a specific or particular way. It follows its own dynamic from region to region depending on the kind of resources the farmers have. Given the fact that most of the farmers are small farmers with limited resources, crop rotation is determined by a variety of factors, which could include availability of seed, availability of credit and access to market. Imposing a rigid rotation system on small farmers will not be practically possible in India.

Apart from stringent field preparations, farmers would have to maintain accurate records and field maps for IP certification so that the crop history could be traced backwards. The majority of Indian farmers have small land holdings. The level of literacy is low, and farmers who might be very wise in agricultural systems would on the other hand find record-keeping of this kind very difficult. This approach, well accepted in the industrial agricultural paradigm, is alien to the way of doing agriculture that exists in developing countries. For example, it was observed in the case of Bt cotton that the mandatory requirement of maintaining the 20% refuge for the Bt crop was very difficult for farmers to understand. This was principally owing to the fact that refuge management and targeted pesticide use is a complex and alien system of growing crops which farmers were not able to implement. The situation was exacerbated by the fact that nobody really taught the farmers how to do refuge management, nor again explained why it was important in order to maintain pest resistance.

Identity Preservation

Identity preservation has been used for hundreds of years. The most common use was in seed production and certification. IP starts with pure seed, followed by proper handling and storage of the IP crop to avoid mixture with other crops. All farm equipment, and storage facilities must be thoroughly cleaned. Every stage of the crop production must be documented, and there must be a paper or electronic trail of every step to ensure complete traceability from seed to end product. This has become critical in the segregation of GM and non GM products.

Potential Points of Contamination

Starting with the seed, varietal purity can be affected at many different points in the production of IP crops. All these stages are very vulnerable to contamination under Indian conditions.

Seed source. It is extremely important in IP production to specify a very low tolerance of varietal impurity in the seed source, if the IP contract specifies a very low tolerance for varietal mixture. If the varietal mixture (contaminant) happens to be a higher yielding variety, the mixture in the resulting crop may worsen.

The land requirement. Contamination can occur from the choice of the land for IP production. Volunteer plants from the previous crop may produce seeds that will contaminate, or, on cross-pollinating, crops may pollinate the IP crop, causing mixture.

Isolation. Close proximity to other varieties will cause mixtures at harvest just by imprecise control of harvest equipment. Rainfall during the growing season can shift plants from other varieties nearby. In cross-pollinating crops pollen from nearby (and even not so nearby) fields may cause varietal mixture.

Planting. A mechanical mixture of seeds of other varieties can occur very early in planting.

Harvesting. Harvesting equipment must be thoroughly cleaned between varieties. This includes the combine and any equipment used in handling and transporting the crop. Care must be exercised in manipulating the equipment around other fields planted nearby. This is difficult, if not impossible, as will be noted presently.

Storage. Storage facilities need to be completely cleaned. This includes handling equipment as well as the storage containers.

Handling and transportation equipment. When delivering the IP product to the next step in the chain the same care is needed in checking and cleaning the equipment used to move the grain from the storage facility to the transportation equipment. The transportation equipment should be checked just prior to loading.

Handling and processing equipment. Care is required with the use of any equipment used in the conditioning and processing of the product.

Equipment design considerations. When considering equipment that will be used to plant, harvest, handle, transport, store, condition, and process IP crops it is wise to observe the ease of cleaning. No equipment is “self-cleaning”. There are many places where seed and other plant materials will lodge in the equipment.

Isolation

In addition to the preparation of the field, the specific manner of cultivation is also important in qualifying for IP certification. One of the most significant aspects of cultivation practices is maintaining isolation from other crops during the cultivation period. Crops that are to be IP certified have to be isolated distinctly from those other crops that are not applying for IP certification. Avoiding the contamination of the IP certified field may be possible to implement in parts of very large agricultural holdings, but in small land holdings, which are closely packed together with narrow separating boundaries, isolating one crop from another would be almost impossible.

This kind of isolation for maintaining purity would only be possible if an entire region was cultivating a single crop aiming for IP certification. If IP certification was something that only a few farmers could afford to attempt, then their neighbouring farmers would become sources of contamination through cross pollination, *via* volunteer plants and weeds. Spatial isolation of such crops seems difficult to achieve. Isolation distances will also vary from crop to crop, depending on the kind of flower, sexual compatibility, pollen quantity, viability, and weather conditions, which would affect pollen dissemination. Isolation distances will be calculated differently for self-pollinating and cross-pollinating crops. Whereas self-pollinating crops like wheat and rice would need smaller isolation distances, cross-pollinating crops, like mustard for example, would require isolation distances of as much as 3 to 4 kilometers. Under Indian conditions this would mean that if a farmer wanted IP certification of his mustard field he would have to make sure that all farmers within a radius of 3 to 4 kilometers of his field were also seeking IP certification. Either the entire region would have to maintain the rigorous system required, or no farmer could seek IP certification, since contamination from neighboring fields cultivating a different crop would be inevitable. This would naturally require that all farmers in the region have the resources, the literacy and the wherewithal to go through the complex and expensive procedure of planting only pure certified seed, maintaining very strict field conditions which would permit almost no contaminating weeds or volunteer plants, having multiple year rotations and maintaining records and field maps. Given the farmer profile in India and other developing countries, this appears impossible to implement.

In the case of self-pollinated crops like wheat and rice the aim of isolation would principally be to avoid mechanical mixture although some extent of cross-pollination would have to be taken into account. One can examine the way in which cultivation of rice, for instance, takes place in India. Starting with transplanting of the rice seedlings the opportunities for mechanical mixture to take place are significant at all stages of cultivation. At transplantation time, several (women) laborers bring their bundles of rice seedlings and put them alongside their fields as they do the transplantation. This transplantation exercise is carried out in several fields at the same time and it is not unlikely that rice seedlings get mixed up during planting. Mix up in rice seedlings is not an issue between farmers, as it is something that happens all the time.

The next stage is the cultivation of the crop. Figure 2 shows how crops in adjoining fields are planted right up to the boundaries so that they are touching each other, and bending into each other's fields. In such a situation, segregation of GM and non – GM crops is not possible.

Figure 2

Neighboring farms in Punjab

Mixture is also inevitable when the crop is being harvested. Harvesting of the wheat and rice crop in India takes place in two ways. The principal way is still manual harvesting and manual threshing though in certain parts of Punjab and western UP, and in some other places where farmers have become resource-rich, harvesting and threshing is done by the Harvester-Thresher combine. When the rice is to be threshed manually, the harvested crop is taken to the threshing area in bundles. Threshing areas in the village are normally common areas where people stock their harvest. Usually there will be a central area, an open space where the ground has been prepared with mud and cowdung to make it hard. This is where threshing takes place. It is possible that two to three farmers are threshing their grain at the same time (See Fig 3). Mechanical mixture at this stage is not just a possibility it is practically inevitable. The possibility of mixture continues further as the grain is bagged and stored.

Figure 3

Common threshing area in the village (Uttar Pradesh)

In the case of mechanised harvesting and threshing too, the possibility of different crops getting mixed remains high since the same harvesting-threshing machine could harvest 5 – 10 fields a day, depending on their size. Harvesting is a continuous process from field to field without the harvester being cleaned in between the harvesting of two fields. Grains from several fields that the harvester combine has gone through will be mixed with each other. Figure 4 from the 2003 rice harvest in Punjab shows an instance of mechanised harvesting where three to four farmers have harvested their crop with the Harvester-Thresher combine. Their produce will be divided in the right proportion, bagged and taken to the agricultural marketing centre for sale. Farmers also do transportation of the grain from the field to the marketing centre jointly, so
mechanical mixture of grain happens at all stages.

Figure 4

Mixture of grain between the harvest of three farmers after mechanized harvesting (Punjab)

After threshing, some grain is kept for domestic use, while the rest is disposed in various ways. It may be sold to rice mills, sent for export or procured by the government. Rice and wheat are procured by government agencies like the Food Corporation of India. This initiative has two purposes. One of them is to store a certain amount as buffer stocks so that in the event of a failed monsoon or a natural calamity, food can be rushed at short notice to the affected areas. India has a tradition of maintaining buffer stocks since the Green Revolution, which enabled surplus cereal production. The second purpose of grain procurement by the government is to obtain foodstocks for the Public Distribution System (PDS). The PDS is a network of outlets across the country, which sells subsidised food to the poor who live below the "Poverty Line". Procurement of food grains is a major exercise undertaken by the government at both the principal harvest times of wheat and rice. This procurement is done at the marketing centre and also at various village centres where the grain is collected from surrounding areas. Figure 5 shows how grain from various areas is piled for inspection at the marketing centres. This grain is already mixed at harvesting and threshing but further mixing takes place during the days it is lying piled up in huge heaps in the open.

Figure 5

Farmers' harvest lying in the open for inspection and procurement by government agencies (Punjab)

After inspection by the Food Corporation of India, the grain is procured and transported for storage to the central warehouses. The Central Warehousing Corporation (CWC) stores the grain in its warehouses, from where it is sent off for the Public Distribution System in each of the states. A certain amount is kept back as the buffer stock for adverse times. Large-scale mixture of food grain takes place during storage and transportation. The system is required to store and transport large volumes of grain under fairly minimal conditions. As food grain production has increased, storage facilities have not kept pace.

The Central Warehousing Corporation is forced to store large amounts of grain stocks in the open, under very simple conditions, covered merely by waterproof canvas.

In fact, the Food Corporation of India admits that it cannot even segregate high value Malwa wheat, which is a durum wheat, with about 13% protein content, from the ordinary wheat varieties, which contain 9 – 10% protein. Even the high protein, high value and more expensive durum wheat is mixed up at the time of procurement because that is the way the system of the agricultural procurement works at present. In the prevailing system, it is easy to see how difficult it would be to maintain the segregation of GM and non – GM crops. Where in any of these stages will it be possible to introduce an IP certification and how under such agricultural conditions could an IP system work in India?

Within the Central Warehousing Corporation, which is the final storage place, there is inadequate capacity, and there is no system for segregating different kinds of grains. The labour force that handles the grain is untrained, and largely illiterate. Building capacity for identity preservation will be a daunting and expensive process. As regards equipment and facilities, an IP certificate system requires that all the equipment that is associated with the crop production cycle, the field maintenance, the harvesting, threshing, inspection of grain etc., must be cleaned and inspected both before and after every use. This has to continue up to the stage of milling and packing the rice, or in the case of wheat, grinding the wheat into wheat flour. All the machinery and equipment in the wheat and rice mills would have to be inspected and certified. The processing of rice and wheat is done in a fairly simple way in small units, mostly in rural areas. Under these conditions, the segregation of GM and non – GM or GM and organic, or organic and ordinary crops would be completely impossible.

In developing countries like India, where agricultural practices are very different from those in the west, the operational costs of such a system would make agriculture such an expensive activity that it would be out of the reach of most farmers. The sampling and testing that would be required of the agricultural commodity from time to time at various stages would also be difficult, from seed stock sampling to field sampling to post-harvest samplings. All of these are very technical procedures for which technically trained manpower would be required, further adding to the cost of the produce. And after going through this expensive procedure, if contamination were to take place, which is almost certain under Indian agricultural conditions, then the costs invested would not be recovered by the farmer, thus leading to great hardship.

Labelling the produce would be yet another difficult area of implementation because records must be maintained of all field designations, the harvest, how much was harvested, where it was stored, how it was stored, how it was transported and the mode of transference. The identity preserved products must be identified, segregated and labelled at all junctures in the market chain. What does labelling mean under conditions like those prevailing in India? Figures 7 and 8 show how food is marketed, both at the wholesale and at the retail.

Figure 6

A grocery store in Delhi.

Figure 7

Retail storage of food grains (Delhi)

In the big marketing centres for grain or for fruits and vegetables, bulk amounts are traded in the market and these are not kept separated. They are stored either in the open or, as in the case of fruits or vegetables, in large godowns. They will inevitably get mixed up, as Figure 9 shows, so that segregation of fruits from various parts of the country or cauliflowers or any other vegetable that is coming into the marketing centre, is not being done, and would be difficult to implement.

Labelling food is possible when food is bought through the supermarket where individual packages are labelled as GM or organic or non – GM or GM – free etc. In India and in many developing countries, especially in Asia and Africa, food is not bought in supermarkets. In India, for example, food is bought in grocers' shops, where large amounts of food are kept in open sacks or in open bins and the consumer buys as much as he or she wants. There are perhaps 10 different kinds of rice, maybe another 10 different kinds of legumes, several varieties of oil, all kept in large containers next to each other. Among the 10 different kinds of rice lying next to each other in open sacks, mechanical mixture takes place all the time. The same container may be used for taking out the rice from different sacks, and the same scales will be used for weighing them. Although India has taken the position in the Codex Alimentarius that it will label genetically modified foods and the Consumer Protection Act of India grants the consumer the right to choose the kind of food that he or she wants, labelling will be very difficult to implement. Even when implemented, it would be meaningless for 90% of the consumers, who would be unfamiliar with the questions raised about GM crops.

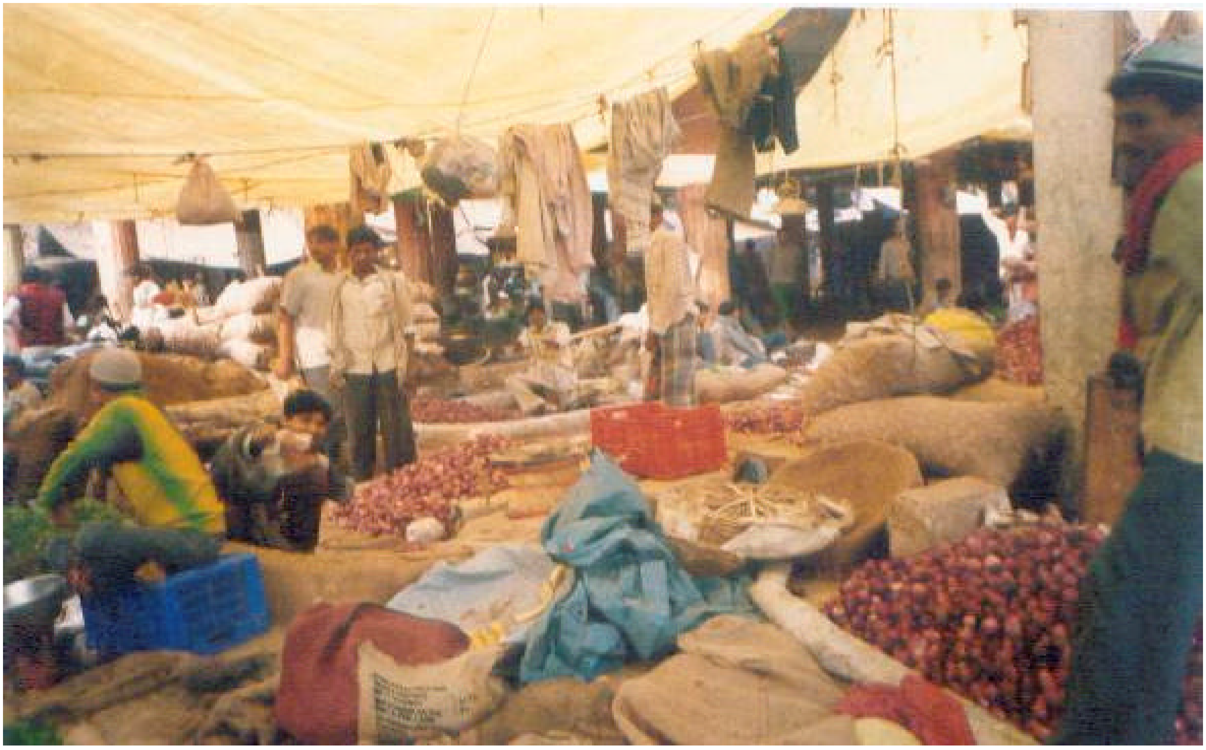


Figure 8

Wholesale market of fruits and vegetables (Delhi)

Regarding the cost of implementing identity preservation, it is increasingly being recognised that the estimations done in the United States were not realistic and that IP costs were heavily underestimated. Especially in developing countries the operational costs of IP systems could be so significant as to actually put the food supply into jeopardy were it to be implemented. In other words, coexistence cannot be implemented in India.

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