

Reviewing Socio-Economic Impact Analysis (Annexure: 54) of GM mustard submitted by CGMCP to GEAC

Executive Summary:

This report is based on the 6 page socio-economic impact analysis entitled “Socio-Economic Impact Analysis” prepared by the GM Mustard developer. It is an inadequate and superficial document prepared with insufficient data / experience about yield, area and farmers’ choices. Below we explain why. For reasons best known to them, the GEAC and its subcommittee have not verified these aspects and have also conveniently avoided discussions about it. Now the regulator states that it is neither responsible for checking the socio-economic impact nor is it expected to verify the claimed yield advantage over currently cultivated mustard hybrids. With this stand the regulator, GEAC has exempted the developer from establishing the basic yield claim of the same.

It is clear from this alone why the apex biotechnology regulator GEAC is singularly unwilling to make the full biosafety data public despite the orders from the Central Information Commission (CIC). This makes a strong case to demand full, complete test reports to be made public and also made available in regional languages. Therefore, we once again urge that the Environment Ministry make the full data accessible to the public and give citizens and independent experts sufficient time to examine it and give their feedback.

Some of the critical shortcomings of the analysis are:

1. **Projection of higher revenue and saving of import bill due to higher production of GM mustard is faulty:** One of the basic premises in this case is the large scale adoption of this mustard.
 - a. Hybrids do not cover more than 11% of cultivated area and no single cultivar has been taken up in 10% of the growing area in mustard in last 15 years. Projecting adoption of 10-25% of area shows a lack of scientific understanding about the risks of mono-cropping and social realities of crop adoption.
 - b. The proportion of DMH series is negligible (0.5%) and the projections made in the past about coverage of DMH-1 hybrid was never realized.
 - c. Farmers do not adopt small seeded cultivars - GM mustard has 27% to 43% smaller seed than mostly adopted cultivars.

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- d. GM mustard was not tested in majority of the states except Rajasthan (where trials had to be abandoned due to objections from the government) for which projections have been made – like the major mustard growing states Haryana, UP, MP and Gujarat.
- e. The market is highly competitive with at least four major companies selling high yielding mustard cultivars and hybrids.

2. How production and yield related projections are unrealistic: High yields and the concomitant increased production of mustard is the main argument put forth to consider this GM mustard (which supposed aid the reduction of the import bill) but even the basic assumptions made are faulty.

- a. GM mustard is a low yielder: As per the results of another experiments carried out by the developer itself, at least 5 high yielding hybrids are already available in the market that yield more than this GM mustard.
- b. The area under mustard is shrinking due to various reasons, particularly unfavourable policy climate. The introduction of high yielding hybrids has not improved the situation and it is highly unlikely that this GM mustard will change it.

3. Other Limitations of Socio-Economic Impact Analysis:

- a. **The GEAC sub-committee misleads:** The sub-committee has conveniently ignored the (highly inadequate) socio-economic analysis in its review. It makes a statement that the GM mustard hybrid under review performs better than its parental lines, however it ignores the question whether this GM hybrid is better than presently cultivated high yielding cultivars.
- b. **Impact of GM mustard as an HT crop is completely ignored:** The promoter and regulator have completely ignored the impact (ecological, health, socio-economic) that this GM mustard could have due to it being an HT crop. Also ignored is the fact that the crop is tolerant to glufosinate, the herbicide largely produced in India by Bayer, which would lead to unholy profits for the company if the crop is adopted as projected.
- c. **Impact on organic farming, organic food industry and honey industry is ignored:** The trade, certification, contamination, production, export related impact on the organic farming, organic food and honey industry is completely ignored despite the fact that Genetic Modification is not permitted in organic farming and mustard is one of the primary forage crops for honey bees.
- d. **Details of IPR are missing:** While talking about this public sector GM mustard the fact has been conveniently ignored that at least five genes/processes utilized to prepare this GM crop are patented and the Material Transfer Agreement (MTA) and other facts have not been presented.
- e. **Socio-economic impact of contamination of indigenous seeds** is completely ignored, so is the impact on organic farming and right to know one's food and choose safe food.
- f. **Impact on Ayurveda and Siddha systems of medicine** is also ignored. This was one of the major reasons for the moratorium on Bt brinjal.

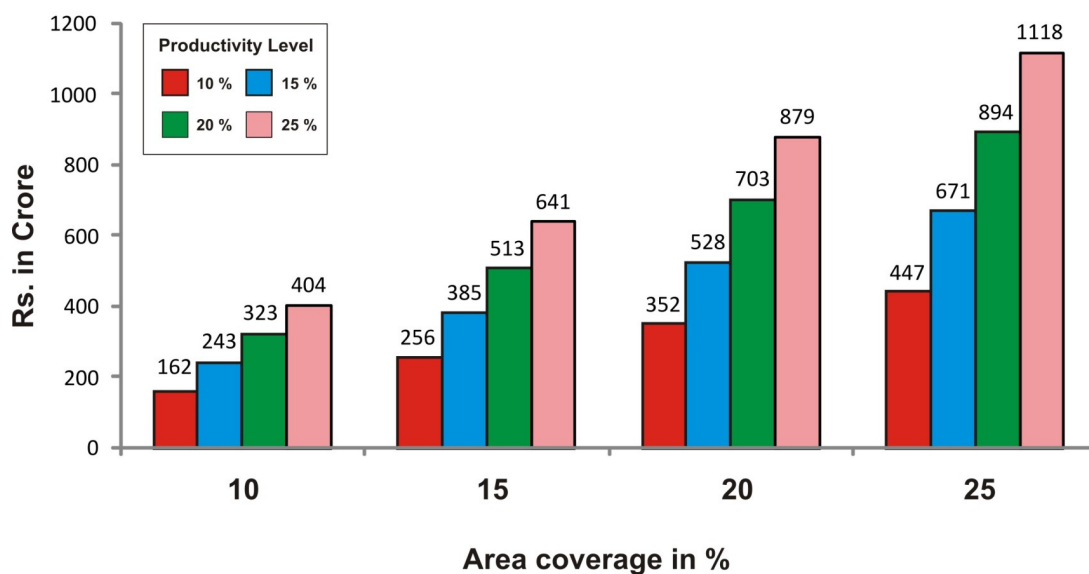
When this GM mustard hybrid is disadvantaged on so many counts it becomes a plausible argument that the adoption and acceptance is hinging on the use of the herbicide tolerance trait. This mustard is a Trojan horse to get herbicide tolerant GM crops and GM food crops approved in India.

Projection of higher revenue and saving of import bill due to higher production of GM mustard is faulty:

The very reason for application for release of GM mustard is the claim that it will increase the production of mustard in India. The Annexure No. 54, titled “Socio- Economic Impact Analysis” is (just) a six page document, which boasts how the release of DMH-11 will increase the production. The developer has used different projections related to increase in productivity and coverage area for cultivation (in five states) to calculate the possible economic benefit by commercial cultivation of GM mustard. The projections (based on highly exaggerated claims) are presented in graphical forms, which are presented below. Not surprisingly the regulators have not verified these claims and they have washed their hands stating, “our job is limited to ensure biosafety, we shall not verify yield related claims” in personal communication. Then the question remains, who is in charge of verifying these claims, while the fact remains that the “Socio-economic Impact Analysis” is a part of the biosafety data. We present here how these claims are untenable, making a strong case for immediate release of full biosafety data to public through the Ministry website. This is just an example of how developer and regulators are hoodwinking the nation.

The following three graphs are from the six page socio-economic analysis:

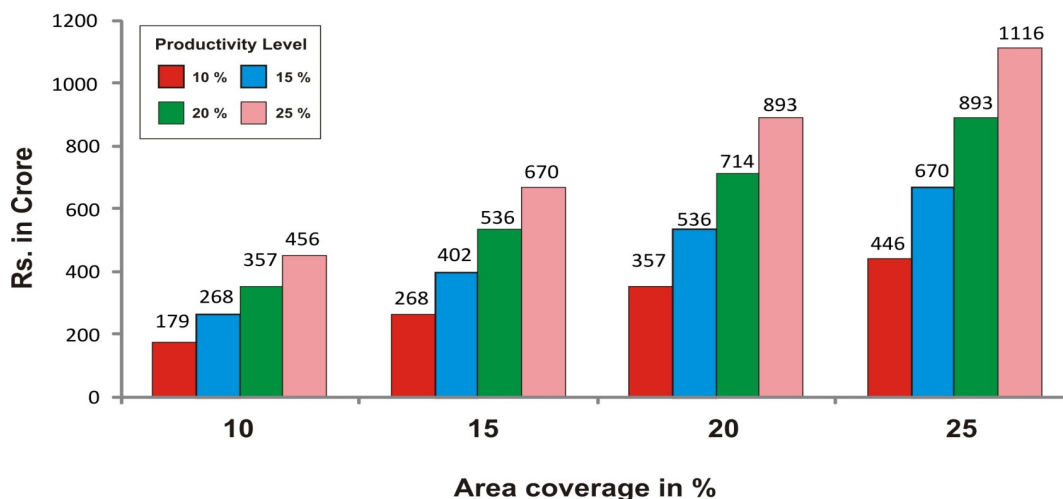
Projected Additional Revenue from Higher Production at different area coverage & productivity levels in 5 states (Rajasthan, Haryana, UP, MP & Gujarat)



Ref : Annexure 54 : Fig.9 of Socio-Economic Impact Analysis

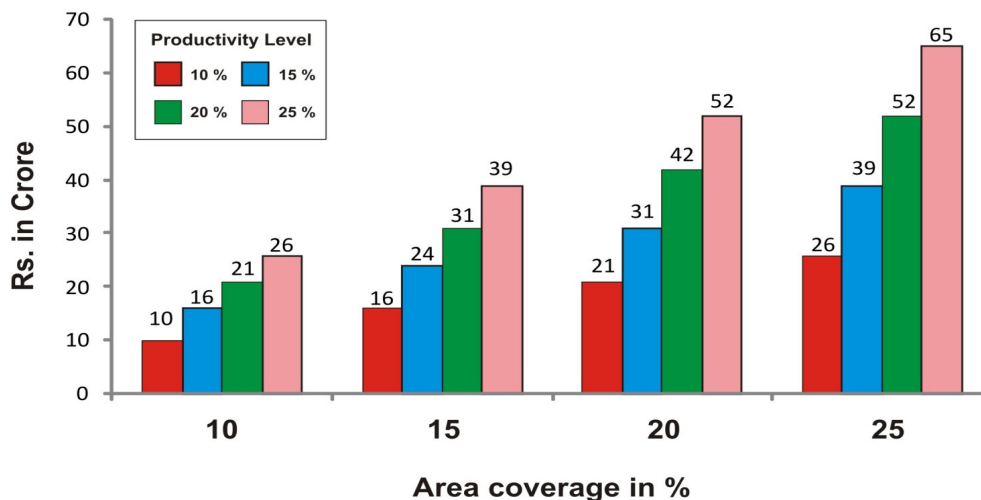
Based on the projections made in the above mentioned graph, two more graphs are shown in the same Annexure as mentioned on next page.

Projected Savings from Import of Edible Oil at different area coverage & productivity levels in 5 states (Rajasthan, Haryana, UP, MP & Gujarat)



Ref : Annexure 54 : Fig.10 of Socio-Economic Impact Analysis

Projected Additional Revenue from Export of Oil Meal at different area coverage & productivity levels in 5 states (Rajasthan, Haryana, UP, MP & Gujarat)



Ref : Annexure 54 : Fig.11 of Socio-Economic Impact Analysis

These graphs make the following claims / projections by the developer:

1. GM mustard will cover 10% to 25% area under cultivation.
2. GM mustard will increase yield ranging from 10% to 25%.
3. GM mustard will fetch Rs.162 crore to Rs.1118 crore more due to higher production, Rs.10 crore to Rs. 65 crore by producing extra amount of oil meal and will save oil import bill by Rs.179 crore to Rs.1116 crore by producing extra amount of oil.

Let us verify these claims based on facts:

How area related projections are unrealistic:

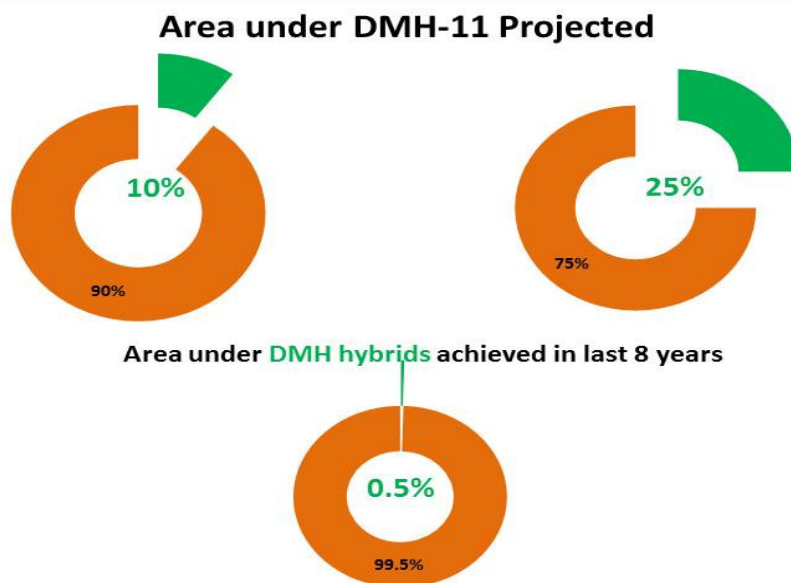
1. Hybrids did not cover more than 11% of the area in the last eight years:

In India, the first mustard hybrid was released in 2008¹, since then seeds of at least four public sector and eight private sector (from 4 companies)^{2,3,4,5} mustard hybrids are being sold to the farmers. But the area under hybrids is estimated to be 11% (about 6.6 lakh ha out of about 60 lakh ha)⁶ of mustard cultivation even after 8 years! Most farmers use farm saved seeds and those who buy from the market prefer non-hybrid cultivars.

2. Share of DMH series is negligible with respect to total cultivated area:

Up till now, the developer of GM mustard, Centre for Genetic Manipulation of Crop Plants (CGMCP) of Delhi University has given three non-transgenic hybrids to the farmers viz., DMH-1, DMH-3 and DMH-4. Based on their recent document⁷, total seed produced for DMH-1 and DMH-4 in 2014-15 was 54 tons and 55 tons respectively. DMH-3 seems has not been promoted. So, the estimated total cultivated area under DMH series in 2015-16 cannot be more than 27,250 ha (@ 4Kg seed/ha, let us believe that full stock of seed produced has been sold and sown, which can hardly be a reality). This means that the **estimated share of area under DMH series cannot be more than just 0.5% of total area under mustard.**

**Unrealistic Projections about Area under DMH-11
Reality Check**



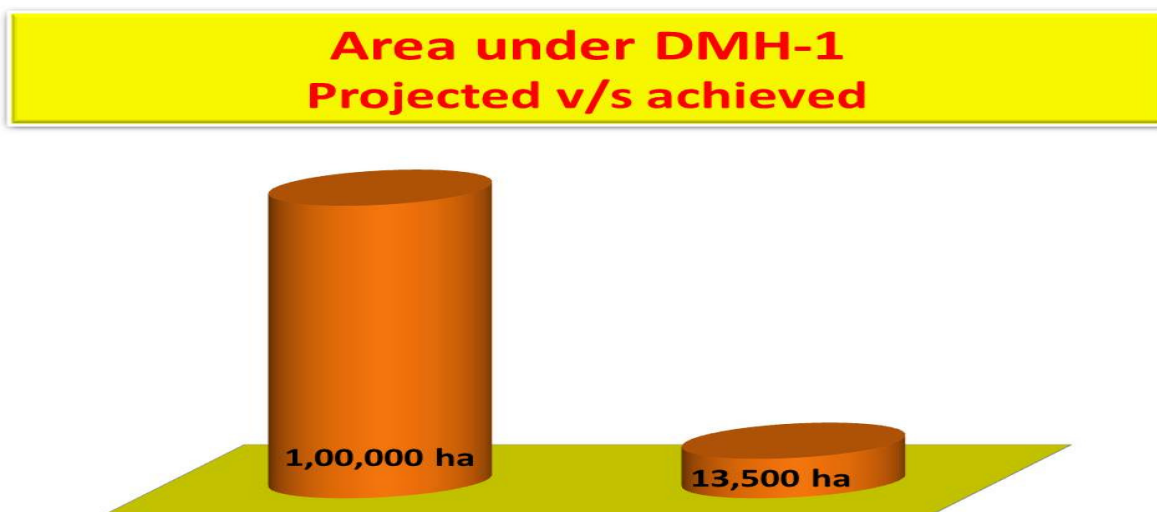
Field expert says that area under DMH series is still shrinking (one should check why the seed production figures of 2015-16 are not given in the document⁷ prepared in August, 2016?). On what ground has the 10% to 25% area for one GM mustard cultivar estimated?

3. Farmers do not adopt small seeded cultivars - GM mustard has 27% to 43% smaller seed than mostly adopted cultivars:

Adoption of cultivars by farmers depends on many factors, not just yield. In a report⁸, the same developer has clearly mentioned that small seed size is the major reason for failure of their own first hybrid called DMH-1. It fetches lower market price for the farmers. Test weight of GM mustard is even less (by 9%: 3.3 gm)⁹ than the rejected hybrid (DMH-1: 3.6 gm)¹. The test weight of the best adopted cultivars by Indian mustard growers is 4.5 gm to 5.8 gm¹⁰. This means the seeds of GM mustard are smaller by 27% to 43% compared to best adopted cultivars. How can the developer project that GM mustard (even smaller seed than rejected hybrid) will be adopted by the farmers? Or is it the unmentioned expectation that the herbicide tolerance trait will make the GM plant acceptable?

4. Has projection made in the past by the developer been achieved? NO:

It is projected that at least 10 lakh ha (about 16% of total cultivated area in India) will be covered under DMH-11(GM mustard) by 2020 in a recently submitted document⁷. Let us check this with history. The same developer has projected to cover 1 lakh ha under their first hybrid (DMH-1) in 2010 in a report⁸ to NDDDB, the funding organization. DMH-1 was promoted through cooperatives, private companies and through distribution of kits under govt. schemes. But as described earlier just 54 tonnes of seed of DMH-1 was produced in the year 2014-15, which can hardly cover 13,500 ha of area in 2015-16. This means that DMH-1 did not even reach 14% of their projection after 8 years of release!



5. Monoculture is highly risky: Cultivation or adoption of a single cultivar in such a large area as projected is highly risky, scientifically NOT advisable and cannot be recommended. Making such projections is itself proof of lack of scientific understanding about limitations of monoculture.

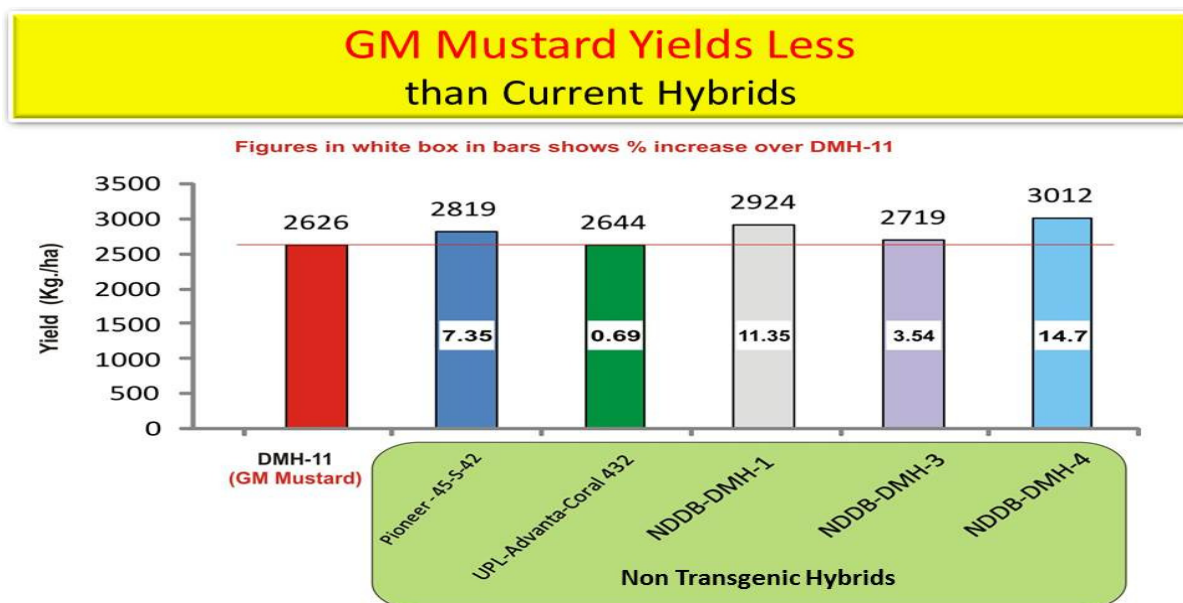
6. **Competitive disadvantage:** Already at least four major seed companies are selling hybrid mustard seeds and more companies are about to bring hybrid mustard into the market. Both public and private sector have a good number of non-hybrid cultivars recently released in the market with various other characteristics, preferred by farmers. How will this GM mustard capture at least 10% coverage in competitive market?

7. **GM mustard is not tested in majority of the states for which projection is made:**

The projections of productivity and yield are made covering five states- Rajasthan, Haryana, UP, MP and Gujarat. The fact is that this GM mustard has not been tested in any of these states⁹ except Rajasthan. It is worth noting that the Chief Minister of Rajasthan has categorically denied approving it for Rajasthan¹¹, which grows about 45% of mustard in India. So projection of large areas being taken up for cultivation is highly unrealistic.

How yield / production related projections are unrealistic :

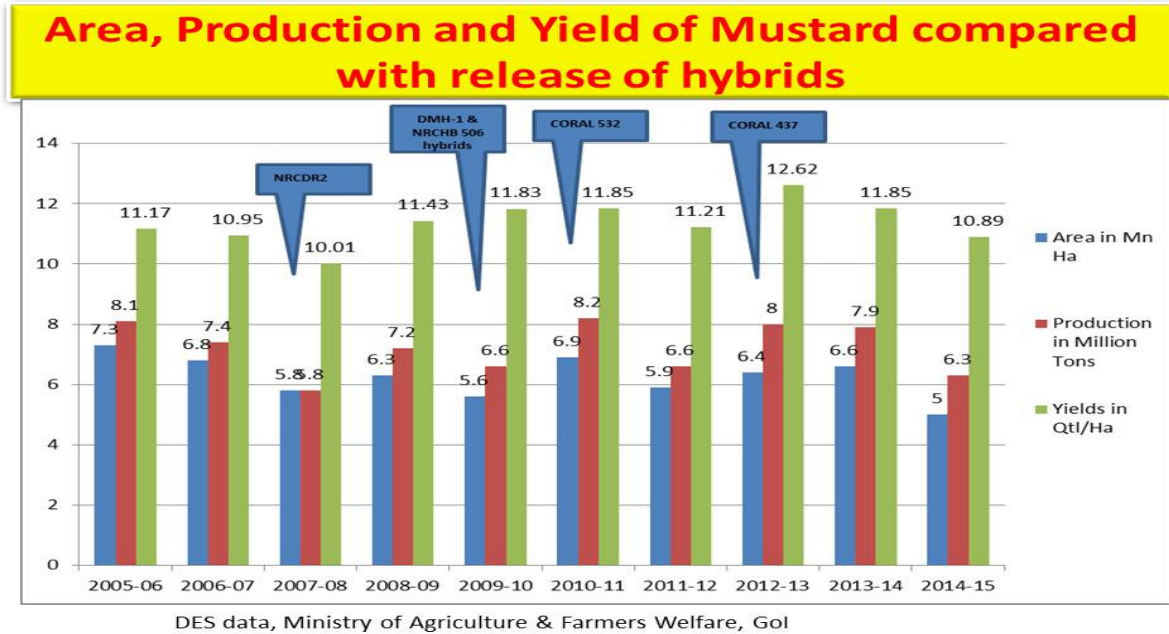
1. **GM mustard is low yielder :** As per the results of other experiment¹² carried out by the developer itself, at least five high yielding hybrids are already available in the market that yield more than this genetically modified GM mustard. There could be more hybrid and non-hybrid cultivars producing more than GM mustard (DMH-11) under field conditions. The real benefits in terms of yield related claims can only be assessed by comparing this GM mustard with currently grown high yielding cultivars in different agro-climatic conditions - that has not been done. And neither the developer nor the regulators intend to do that. The following graph compares the yields of existing high yielders¹² with average yield achieved during BRL testing of GM mustard.⁹



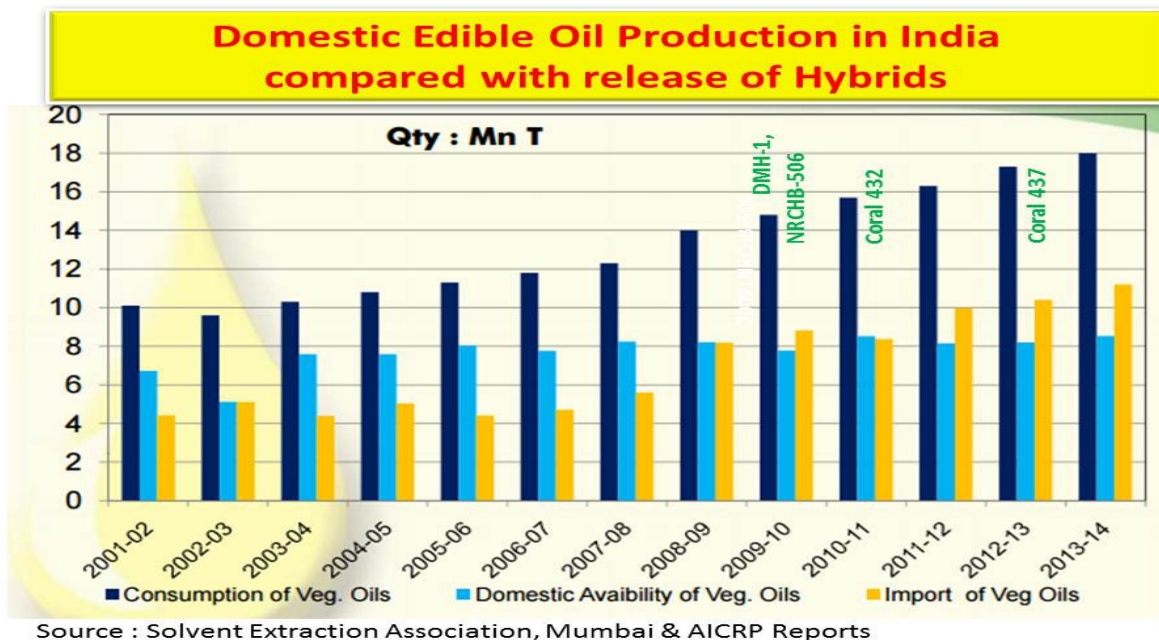
Ref : 1. Data of DMH-11 is the average of 8 trials conducted under Bio-Safety Research Level (BRL) – I & II.
 2. Data of Non Transgenic Hybrids are taken from “Heterosis Breeding for Improvement of Indian Mustard” – Presentation made by Dr. Y S Sodhi of Centre for Genetic Manipulation of Crop Plants, University of Delhi South Campus on 20th Feb. 2015 at National Seminar entitled “Strategic Interventions to Enhance Oilseed Production in India” organized by Indian Society of Oilseed Research.

2. Area under mustard is declining:

Due to various reasons, mainly unfavourable policy support for growers the area under mustard is decreasing¹³ and release of high yielding hybrids has not translated into increased area and hence production has also not risen as evident below.



Even after release of high yielding hybrids, the import of rapeseed and mustard oil has increased from 14,000 tonnes to 3,56,000 tonnes from 2009-10 to 2014-15¹⁴. Likewise, release of high yielding hybrids has not made any significant increase in the domestic edible oil production in India.¹⁵



So, the economic projections made in the Annexure: 54 are not based on facts, they are highly exaggerated, unrealistic and misleading.

Role of GEAC is Biased, Unscientific and Misleading:

With this back ground it is worthwhile to discuss role of the GEAC (through its subcommittee) in verifying these projections and claims about socio-economic impact. **In fact the AFES report¹⁶ does not comment on the “Socio- Economic Impact Analysis”.** It has neither accepted nor rejected the claims made in the Annx: 54. It has cleverly chosen to reproduce the three year yield data separately in its report (page102). **The sub-committee even refrained from showing three year average in a single table and conveniently played safe by not discussing anything about yield advantage over comparators.** Honest and neutral regulators should have discussed the many violations observed (with respect to their own permission letter and recommendation made under AICRP, especially about using recommended checks) during conducting agronomic trials. However, **our biotech regulators have decided to deliberately overlook one of the fundamental failing of this GM mustard - its faulty yield and productions increase claims.**

Heterosis is considered as a proof- of-concept for pollination control technology- What an unscientific approach!

On the other hand, the subcommittee added a sentence (on page 103 of AFES report¹⁶) in a concluding paragraph saying **“The Hybrid DMH-11 is the result of cross between Varuna bn 3.6 and EH-2 mod bs 2.99 is superior to the parents proving proof-of-concept of the technology and showing heterosis and hybrid vigour”.** Please note the phrase use “superior to the parents”. **It neither mentions “superior over checks” nor “superior over currently grown cultivars”.** **This is a proof how GEAC is colluding with developer in fooling the nation over yield claim.**

Let us understand what requires as the “proof of concept” with scientific rigor. The transgenic technology (Bar-Barnase-Barstar system) used to develop GM mustard is meant for pollination control (making female parent male sterile and restoring male fertility in its offspring- the F1, called DMH-11). Considering heterosis or yield advantage “OVER PARENTS” as a proof of concept for technology meant for pollination control is completely unscientific, misleading and laughable.

Earlier mustard hybrids developed by the same developer using **non-transgenic sterility management system (Cytoplasmic Male Sterility- CMS) has shown 32.6% and 29% heterosis** in multisite farmers’ field demonstrations in 2004-05 (10 trials) and 2005-06 (27 trials)¹⁷ respectively. These figures are higher than the claimed (28.4%) heterosis achieved for DMH-11⁹. This means even without transgenics higher heterosis has already been achieved. Heterosis has no connection with pollination controlling transgenic technology (B-B-B technology). **Heterosis is wrongly considered as proof of concept for pollination control technology.** Can we consider higher body weight over parents of a vasectomized person as proof of concept of technology of vasectomy (or its reversal)? **What a kind of science our regulators are promoting?**

Other Limitations of Socio-Economic Impact Analysis:

1. **Impact as an HT crop is completely ignored:** There is no mention that GM mustard and its parents are Herbicide Tolerant (HT) crops and how HT mustard will make an impact on rural livelihood and nutritional security, especially for following class of people:
 - a. women, who engage themselves in weeding work.
 - b. animal keepers not having their own land and rely on the fodder grown on bunds and weeds.
 - c. rural poor, for whom some weeds are source of leafy vegetables.This is in addition to the serious problems that have been experienced with Ht crops the world over with excessive use of herbicides and development of superweeds.
2. **Impact on honey industry is ignored:** There is no mention about impact on honey industry with respect to employment, quality, price and export- with its social and economic concerns.
3. **Details of IPR are missing:** The IPR scenario of GM mustard hybrid and its parents along with full details of Material Transfer Agreements (MTA) involved should be a part of the biosafety dossier submitted – the regulators should mandate this, along with copies of MTA to understand the exact terms and conditions of the IPRs involved in each case. At least five genes/ techniques associated with these parental lines are patented⁸ and it is important to understand the full ramifications.
4. **Socio- Economic impact of contamination is ignored:** There is no mention about socio-economic impact for farmers, whose native seed will be contaminated (forever and that too irreversibly) and the scenario where they will be unable to save their seeds or maintain purity of seeds and lose control over them.
5. **Impact on organic farming and food business is missing:** There is no discussion on the socio-economic impact on organic and GM-free farming, with the fact that at least nine states of India are implementing their organic farming policy and the Central Government is also running schemes to promote organic farming in a big way. Sikkim, the first organic state announced by the Honourable Prime Minister also grows mustard. What will happen to organic mustard grown over there? The organic food industry- certification, processing, retail and export market will face serious negative impact if GM mustard is grown in Indian fields. India was the largest organic cotton exporter at one time and GM cotton has had a negative impact on the whole business¹⁸. Why are these facts ignored in the socio-economic impact analysis?
6. **Impact on right to know and choose safe food is missing:** As we are aware India has put in place a perfunctory labeling law for dealing with GM foods and GM ingredients in food. Even that is not being implemented by the food regulatory authority (FSSAI). In this context to introduce a genetically modified food that will be used directly as vegetable and oil will definitely lead to loss of choice for consumers to keep their food GMO free.
7. **Impact on Ayurveda is missing:** There is no discussion about socio-economic impact of this GM mustard on Ayurveda medicines and its practitioners.

CONCLUSION:

1. The developer has prepared a six page socio-economic impact analysis using primary school level calculations based on unrealistic estimates without considering ground realities, history and their own experience about yield, area and farmers' choices.
2. The GEAC and its subcommittee have not verified these claims, and has conveniently avoided discussion and evaluation of the socio-economic impact analysis as well the claims of yield advantage over checks and currently cultivated high yielders. By doing so, the GEAC has blessed the developer for the reasons best known to them.
3. It is quite understandable why GEAC does not want to make the data public as THEY do not want the nation to know how its citizens are fooled.
4. This is just a sample, there is no reason to believe that other kind of games have not been played in other tests and reports, which the regulators are consistently hiding.

This makes a strong case to demand full, complete test reports to be made public and also made available in regional languages with at least 120 days' time to comment.

References:

1. Variety release proposal for DMH-1 submitted under AICRP
2. <http://www.advantaindia.com/advanta.php?pgidee=mustard>
3. http://jkseeds.net/jk/index.php?option=com_content&view=article&id=86&Itemid=503
4. <http://www.mahyco.com/products/1/9/row-crops/mustard-hybrid>
5. <https://www.pioneer.com/web/site/india/products/mustard/>
6. Personal Communication with the field expert.
7. Revised Proposal for DBT-UDSC Partnership Centre on Genetic Manipulation of Brassicas Submitted to Department of Biotechnology, Govt. of India in August, 2016
8. Progress Report of NDDDB-DU Biotech Project for March, 2010 to Feb., 2012 submitted to Academic Advisory Committee
9. Biosafety Research Level testing Reports for transgenic mustard submitted to GEAC
10. Personal communication with the expert
11. http://economictimes.indiatimes.com/news/politics-and-nation/gm-crop-not-allowed-in-rajasthan-farmers-for-organic-farming-vasundhara-raje/articleshow/51043896.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
12. Heterosis Breeding for Improvement of Indian Mustard – Presentation made by Dr. Y. S. Sodhi of Centre for Genetic Manipulation of Crop Plants, University of Delhi South Campus on 20th Feb. 2015 at National Seminar entitled “Strategic Interventions to Enhance Oilseed Production in India” organized by Indian Society of Oilseed Research.
13. Ministry of Agriculture & Farmers Welfare, GoI
14. <http://storage.unitedwebnetwork.com/files/23/442ebbefdff63efe97094d4f6dcdbd21e.pdf>
15. Solvent Extraction Association, Mumbai & AICRP Reports
16. Assessment of Food and Environmental Safety (AFES) - A report of the subcommittee (of GEAC) on GM mustard
17. Sodhi, Y.S., Pradhan, A.K., Verma, J.K., Arumugam, N., Mukhopadhyay, A., Gupta, V. and Pental, D. in a note entitled “DMH-1, the first mustard hybrid in India based on a novel CMS-restorer system”.
18. Matthias Kliss *et al.* Influence of the fast spread of Bt cotton on organic cotton production: Examples from India and Burkinafaso available at http://orgprints.org/26216/1/2012_Kliss_SCAUBGA.pdf