Bt brinjal: premature approval for cultivation

Following the publication of the Expert Committee II (EC-II) report[1] and the Genetic Engineering Approval Committee (GEAC) decision, approving *Bt* brinjal for cultivation in India, there has been considerable discussion on the topic in public fora and the media. Surprisingly, there has been very little scientific debate or discussion on this topic in India[2,3]. Though I am not a biologist, this brief note summarizes some of my concerns as a scientist and a citizen.

(a) Relevance to reality: To preclude contamination, the apparently successful field trials involved maintaining an isolation distance of 300 m (p. 5)[1], based presumably on some national or international standards. Standards are necessary to ensure that reported measurements can be duplicated scientifically and compared, and to evaluate the influence of other variables systematically. However, it is necessary to check the relevance of the standards to reality. Brinjal is grown primarily by small farmers in India[1]. Assuming a small one acre square farm, would be 63 m long, in which a small farmer would generally grow many different crops. It is essential that one considers realistic separation conditions of 1–2 m in India to ensure that there is no contamination of non-GM crops.

(b) Response to critical comments: While we may not agree with all critical comments made by independent referees, scientific manuscripts usually benefit from an open consideration of the comments, frequently with additional experiments and/or analysis. The 102-page EC-II report devotes 34 pages for responding to critical comments and the report finds essentially no value or basis for any of the comments! While apparently detailed, it also appears that it does not consider the comments seriously. Just as an example, there was a comment on the need for chronic (long-term) toxicity testing, which the report brushed aside. A recent statistical analysis of earlier data suggests strongly the need for chronic testing[4].

(c) Conflict of interest: Independent studies, transparency and availability of all data, and independent evaluation are some of the hallmarks of good science. There is sufficient historical information available to warrant caution in accepting and relying solely on data provided by potential financial beneficiaries. Recently, independent analysis of data obtained by a GM company has led to serious doubts on the validity of the tests and conclusions reported earlier to regulatory agencies by the company[4]. Clearly, independent studies and evaluations are necessary before approving *Bt* brinjal.

There are also other important broader societal concerns that need to be addressed, relating to biodiversity, choice and food security, apart from legal liability. Finally, while scientific debates and controversies are resolved over a period of time by further experiments or analysis using newer techniques, it is important to note that once released, it is not possible to put the *Bt* brinjal gen(i)e back into the bottle. The above discussion leads to the conclusion that it would be premature to release *Bt* brinjal for cultivation, until both the scientific and societal concerns are addressed adequately.

1. http://moef.nic.in/downloads/public-information/Report%20on%20Bt%20brinjal.pdf
2. Bhargava, P. M., *J. Biosci.*, 2009, **34**, 167–168.
3. Padmanaban, G., *Curr. Sci.*, 2009, **97**, 1715–1716.
4. Seralini, G. E. *et al.*, *Int. J. Biol. Sci.*, 2009, **5**, 438–443.

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The neglect of productivity indicators in measuring digital preparedness

In an earlier article[1], I dealt with the practice of adding input and output indicators in prevailing digital preparedness indexes. Methodologically, it seemed to me that for basic economic reasons one should instead or in addition divide the output indicators by the input indicators. Neglect of these productivity calculations could as I saw it lead to misleading estimates of digital preparedness. (It is easy to imagine a case for example where countries with relatively high productivity are ranked below countries with more inputs and lower productivity.) The purpose of this note is to identify some actual cases where the ranking of countries by existing preparedness indicators would change if outputs were divided by, instead of added to, inputs.

Digital preparedness indexes have in common the goal of estimating the readiness for digital technology of different countries. Although there are at least 10 such indexes, the ones associated with the World Economic Forum (the e-readiness index) and the International Telecommunications Union (the development index) are probably the best known and most influential (they receive wide media coverage when the annual rankings are announced). Both cover large numbers of countries and share the practice of adding input and output indicators. For example, skills are added to Internet use which in turn is added to the number of computers (per 100 persons). No productivity calculations are made in the annual reports or anywhere else for that matter and the question is whether the ranking produced without such calculations is the same as the ranking that would emerge from dividing outputs by inputs. My goal is to identify cases where there is a divergence between these indicators. The more the deviations and the greater their intensity, the more one would want to question the reliability of existing digital preparedness indexes. For then, one is likely to encounter perverse cases such as where a country with a low productivity (more inputs per unit of output) is given the same ranking as a country with fewer inputs and higher productivity[1].

I have selected two examples, one concerning the internet and the other with mobile phones (see Tables 1 and 2).

Notice that the last two columns in each table comprise, respectively, the ratio of output to input (where in each case the former appears in the second column) and the addition of the two variables. Thus in Table 1, the division is represented by internet use over computers (in the first row this is represented by 5.2 divided by 1.5, or 3.47. In the same row, the method of adding gives a result of 6.7 (sum of 1.5 and 5.2).

Inspection of the two cases shows that both of them exhibit quite a marked degree of divergence in the rankings. Consider for example the place where divergence occurs in Table 2. In particular, for the ratio method the highest score occurs in the low medium group whereas adding places the high income category in first place. This category also comes last in one of the methods and first in the other. In Table 1 by contrast, the rankings generated by the two methods are diametrically opposite to each other.

Next I focus on the possible explanations of the two tables that exhibit a relatively substantial deviation in the rankings of country groups. Table 1 seems to illustrate more clearly the possible role of sharing information technology; the data in that table point to a declining ratio of internet use per computer. At the lowest income level, one finds the ratio at its highest level (the available computers that is to say are being used more intensively than in any other category). By the time income has reached its highest level, however, there is very little need for sharing and the ratio becomes close to unity. Much of the sharing that does occur may take place in cybercafés, which in many poor countries are the primary source of internet access. In the case of survey evidence from Cameroon, for instance, 'The cyber cafes are the most common places to access the Internet, followed by offices, schools and a tiny minority of houses'[2].

At the high-income level in Table 2, there is no real need for sharing given the total penetration of subscribers (more than 100%) of mobile phones (this is the prevailing situation in most developed countries). Usage is then more a function of high incomes rather than family or communal sharing. At the lowest income level on the other hand one may expect more sharing given the general back of mobile phone subscribers (38.9%). (An interesting piece of evidence is that in a sample of 14 mostly middle income countries, it is a low-income African country, Uganda, which has the highest number of cybercafés per head of the population[3].) According to a survey conducted in Namibia, for example, 'Respondents tend to share their mobiles with family first, friends second and neighbours third. Nearly 30% of respondents regularly share their mobiles with other family members, compared to about 16% with friends.

The percentage of respondents that shares their mobiles with family, friends or neighbours is distinguished by household income. One can clearly observe a trend of higher income households tending to share their mobiles less, which can also be attributed to more mobiles being owned per household . . . It can be observed that respondents living in rural areas are more willing to share their mobiles with others than respondents in major urban or other urban areas. Interestingly, only 2.77% of respondents that share their mobile phones charge friends, family or neighbours a fee for the use of their cell phones'[4].

Other studies confirm extensive sharing of mobile phones by family, friends at low income levels.

I began this note by pointing out that existing digital preparedness indicators are obtained by adding, rather than as economic logic would suggest, by dividing 'outputs' by 'inputs'. I then gave examples where the former method diverges from those obtained by the latter. In these cases, the reliability of existing digital preparedness indexes should be a source of concern to those who promote them for use in rich and poor countries. Some of the divergence, it seemed, could be explained by sharing information technologies at relatively low income levels as often occurs for example in cybercafés.

Table 1. Computers and internet use (2007)

	Computers (per 100 people) input	Internet use (per 100 people) output	Ratio (dividing)	Adding
Low-income	1.5	5.2	3.47	6.7
Low-middle	4.6	12.4	2.7	17.0
Upper-middle	12.4	26.6	2.15	39.0
High-income	67.4	65.7	0.97	133.1

Source: World Bank, at-a-glance tables.

Table 2. Mobile subscribers and mobile telephone usage (2007)

	Mobile, cellular subscriptions (per 100 people) input	Mobile telephone usage (minutes/user/month) output	Ratio (dividing)	Adding
Low-income	21.5	n/a	n/a	n/a
Low-middle	38.9	322	8.28	360.9
Upper-middle	84.1	137	1.63	221
High-income	100.4	353	3.51	453.4

Source: World Bank, at-a-glance tables.

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