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RIS Policy Brief

Access, Equity and Inclusion : Ethical Norms and S&T Policy Outcomes

Introduction

India embarked upon utilising Science and Technology (S&T) for national development in a big way with the formulation of the First Five Year Plan. Since then S&T has been at the core of India's development discourse and there is a consensus on the key role of S&T in nation's socio-economic development.

This consensus has ensured that S&T policy and objectives are beyond political controversies and the nation as a whole has lauded India's atomic energy programme, space programme and various other S&T oriented missions. The latest policy document, namely, Science, Technology and Innovation (STI) Policy of 2013 built upon the earlier policy statements and brought in innovation as focus of policy. It also identified some key challenges in applying S&T for national development in the years to come.

RIS under the Global Ethics in S&T (GEST) Project undertook a two-year research programme on India's S&T policy and policy discourses and the key issues in S&T policy making in the context of globalised S&T, increasing expectations and responses to S&T issues from public and challenges in ensuring that S&T policy contributes to inclusive growth which has emerged as a key concern. This policy brief summarises the key findings from the research and provides some suggestions to policymakers.

STI, Development and Emerging Issues

Science for national development, security and self reliance have been the key objectives of India's S&T policy ever since India developed the First Five Year Plan. While the Five Year Plans have had many important objectives such as agriculture-led growth, socialistic industrial policy, and competitive growth, the contribution of S&T to them has been substantial. Thus, whether it is Green Revolution or White Revolution or ICT-enabled growth in exports in service sector, application of S&T has been the cornerstone of development planning and practice in India. Thanks to the massive allocations to building STI infrastructure and the continuing support, India has been able to capitalise on emerging technologies such as biotechnology and nanotechnology. Globally the shift has been from science policy to innovation policy.[1] Increasing the spending on S&T is one of the ways to achieve leadership in S&T. Realising the innovation potential in S&T is a major challenge as increased spending in S&T is expected to result in more innovations that contribute to socio-economic development and provide a competitive edge. The policymakers envisaged that allocation to S&T should go beyond 1 per cent of GDP so that India becomes a global leader in science.[2] But the trends indicate that this is necessary but not sufficient as China is planning to spend more on S&T and is likely to overtake the USA as the No.1 spender in S&T within a decade.[3] As S&T is more globalised now than before, countries are taking steps to invest more in R&D and realise the innovation potential in S&T.

The STI policy of 2013 points out: "Global innovation systems tend to bypass large sections of the community. Innovation for inclusive growth implies ensuring access, availability and affordability of solutions to

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as large a population as possible. Innovation therefore must be inclusive".[4] It suggests some measures in this regard. However, inclusive innovation is a major challenge for India, China and for many other developing nations.[5]

Inclusive Innovation calls for a different approach in S&T policy making. But traditional indicators of innovation or R&D performance are not adequate to measure inclusive innovation. Current literature on S&T indicators identifies many issues with traditional S&T and innovation indicators and methodologies.[6] Developing suitable indicators for inclusive innovation is a major challenge.

In our research on science policy and inclusion and ethics in S&T policy we identified that in the Indian context Access, Equity and Inclusion (AEI) can be the norms to assess the policy outcomes and measure the impacts of policy and outcomes. Measuring inclusion and exclusion as outcomes of economic policies has been pursued by economists while social inclusion and exclusion as an idea has gained attention in the recent years in the wake of concerns over increasing inequalities and their consequences. Besides governments, agencies like World Bank, Asian Development Bank and UN agencies have initiated research on measuring social inclusion and exclusion and development of relevant indicators.[7] In case of South America, Social Inclusion Index has been prepared to measure social inclusion in different countries.[8] In the Indian context, equity and access have been discussed in the context of higher education while financial inclusion and digital inclusion are also being measured and researched upon. Inclusive economic growth and developing indicators for different categories of inclusion and exclusion have received attention from economists and policymakers. While development of Human Development Indices catalysed research to think beyond traditional economic indicators of growth and inequality, development of indicators to measure inclusion, exclusion and access will certainly complement ongoing efforts to unravel the linkages between growth, development and inclusion.

In the Science, Technology and Society literature the linkages between S&T and inequality, S&T and equity and issues like using S&T to address social inequalities and to facilitate access to basic needs and services have been addressed by scholars.[9] These studies point out that in developing countries S&T and innovation policies can play an important role in facilitating outcomes that are equitable, promote social inclusion and reduce exclusion from services to goods. As patterns of social exclusion and inequality vary across countries and regions and across groups there can be no universal solution. But the need to measure the outcomes of policies through AEI is feasible only if suitable indicators and methodologies to measure AEI are developed. Hence as part of the project, RIS undertook the preliminary steps in measuring AEI based on data on social and economic development in different states in India.[10] The methodology and outcome are described in Box 1.

Major funding agencies like National Science Foundation, European Commission and national S&T ministries/departments in many countries give importance to research on Ethical, Legal and Social Implications of S&T, particularly emerging technologies. Often this type of research is done by units/ organisations that perform technology foresight and assessments while bodies such as Nuffield Council on Bioethics, the Presidential Commission for the Study of Bioethical Issues provide analysis of ethical issues and policy recommendations on an ongoing basis. Besides these, various national academies and professional bodies and science societies such as Royal Society conduct research and publish studies and make recommendations to the governments. A major reason for this is that while the interface between science and society has become complex, policymakers have acknowledged that the views of various stakeholders and public engagement with S&T are necessary.[11]

Public communication of S&T is necessary but not sufficient. The deficit model of public understanding of science has given way to public engagement with science model in many countries. In the last three decades or so, controversies over nuclear energy, GM crops, different technologies in health and medicine and concerns over privacy and

1 Schwachula, Seoane and Hornidge (2014).

2 DST (2010).

3 OECD (2014).

4 DST (2013).

5 World Bank (2013), UNCTAD (2014), Chataway, and Hanlin and Kaplinsky (2013).

6 Gault (2013).

7 Labonté, Hadi and Kauffmann (2011), Eurostat (2013), UNDESA (2010), World Bank (2013) and ADB (2011).

8 http://www.americasquarterly.org/charticles/socialinclusionindex2014/

9 Gault (2011), Mercado (2012), Bozeman *et al.* (2011), Hall *et al.* (2008), Cozzens (2007) and Cozzens and Wetmore (2011).

10 Chaturvedi, Srinivas and Rastogi (2014).

11 European Commission (2009).

Box 1: Measuring Access, Equity and Inclusion and Developing Indicators

AEI categories may be used to develop suitable indicators and they may also be used to bring in a focus in the policy. Analysing the Indian experience in innovation and its linkage with (in)equality Jospeh, Singh and Abraham (2014) point out, "While interpersonal inequality over the years has not aggravated, it has not mitigated to a satisfactory level; inequality across different regions and that between different social groups has increased. Nonetheless India appeared to be more equal today than its counterparts in BRICS countries, providing credence to the constitutional assurance for equity and social justice.

Three indices using Principal Component Analysis (PCA), where weights in each index are the variances of successive principal components, were constructed. PCA is a multivariate statistical approach that uses orthogonal transformation to convert a set of correlated variables into set of uncorrelated variables called principal components. All the indicators were normalised prior to calculating the index, so as to make them scale free. The mean and standard deviation of each indicator were calculated, across the states for a given year and then the indicators were normalised by using the following formula:

$$\frac{X_{is} - \bar{X}}{\sigma_i} \qquad (1)$$

In the above equation, X_{is} is value of an indicator i for state s, $\bar{X}$ is mean of indicator i, and σ_{is} is standard deviation of indicator i. The principal components were calculated as linear functions of standardised variables, where the coefficients of the variables are elements of successive characteristic vectors. The first component is calculated as follows:

$$P_1 = \alpha_{11}X_1 + \alpha_{12}X_2 + \cdots + \alpha_{1n}X_n \qquad (2)$$

In the above equation, $X_1, X_2, \ldots\ldots, X_n$ are n indicators in a given index. Similarly, all the principal components equivalent to number of indicators included in the given index have been calculated. Based on principal components the index is calculated as follows:

$$\text{Index} = \frac{\lambda_1 P_1 + \cdots + \lambda_n P_{n1}}{\lambda_1 + \cdots + \lambda_n} \qquad (3)$$

In equation (3) $P_1, \ldots, \lambda_n = P_n$

Based on an examination of many indicators analysis of changes in the infrastructure for S&T and in social conditions in fourteen states of India was done. The selected indicators were aggregated to form a S&T Index and a Social Index (SI) using a technique based on principal components. Pearson's rank correlation to analyse the changes that might have occurred over the years as well as to analyse the interrelation between the S&T index and the SI was used. Further, the relation between these two indices and economic growth was examined to find out how these are related, i.e. whether states with better indicators have performed better economically, or whether better economic performance has preceded improved indicators.

In case of S&T Indicators the study analysis shows that the rank correlations between the aggregate index of the indicators for the different years is very high so that the same states do well at over the entire period. While it is found that there is some evidence that states with poor indicators have improved their infrastructural facilities, their better performance while narrowing the gap has not enabled them to catch up with those States which have had the initial edge. Based on data we measured the growth of states and their development indictors and our preliminary results indicate that economic growth need not necessarily result in AEI as measured through indicators that consider S&T spending, access to education and other parameters. Based on state level data and social indicators and indicators of economic growth a methodology was developed for estimating S&T index and social index. Preliminary results from this analysis indicate that the relation between the two indices weakens over time. The hypothesis is S&T policy is not leading to inclusiveness. A high S&T index does not automatically result in high growth. Analysis of growth and social index indicates that better social indicators do not necessarily lead to higher growth nor does growth lead to better social indicators. In other words, growth in many states is not inclusive. As the results are preliminary we cannot come to grand conclusions based on them. But a quantitative analysis is important to understand the linkage between S&T policy outcomes and inclusive growth or more/better AEI. This research can be developed further and contribute to the global debate on S&T policy and inclusive innovation.

Source: Chaturvedi *et al.* (2014).

risk have resulted in governments trying to engage deeply with the public, particularly different stakeholders and understand their perceptions and perspectives. Similarly, in Technology Assessment (TA), Participatory Technology Assessment (PTA) and Constructive Technology Assessment (CTA) are supplementing traditional technology foresight and assessment exercises.[12] Thus, today S&T policy has to go beyond its traditional role and is expected to be sensitive to publics concerns and play a proactive role in public engagement. This is necessary for increasing the legitimacy of S&T policy and acceptance of R&D projects and directions in S&T policy, by the public. As S&T and innovation policy is expected to play an important role in the years to come, it is high time that S&T policymakers in India take note of these developments and plan accordingly.

[12] Rip and Kulve (2008), Hennen (2012).

Mainstreaming AEI Analysis and STI Policy

Mainstreaming ethical analysis in S&T policy means giving adequate importance to ethical analysis which in the Indian context means giving importance to Access, Equity and Inclusion aspects and integrating social-ethical analysis in decision making (see Box 2 for detailed historial context). In our view this will enhance the credibility of decision making and provide a better framework to assess the outcomes of S&T policies. An important issue is - are there models for this or will this mean that India should replicate what has been done in the USA and Europe. We are not advocating the position that India should replicate what has been done in the USA and Europe in the name of analysing Social, Ethical and Legal Issues and give importance to traditional bioethics and ethics in decision making.

While mainstreaming social-ethical analysis in S&T policy is important there are many routes/options for that. Mainstreaming is an objective and achieving it is not easy when social-ethical analysis is considered as irrelevant or an impediment for policy making. However, in developed countries some form of social-ethical analysis is performed by different bodies or independent initiatives and often organisations doing TA or advising the governments on TA perform this, while in the USA the Bioethics Commission appointed by the President undertakes such a task as and when required. The erstwhile Office of Technology Assessment (OTA) in the USA also brought in social-ethical analysis in its findings and integrated them in its reports. But social-ethical analysis of technologies received a boost when as part of Human Genome Research, studies on Ethical, Legal and Social Issues (ELSI) were funded with a specific allocation and these studies covered many issues and generated much literature on ELSI aspects of Human Genome Research. Similarly, in Europe ELSI aspects of genome research and specific technologies like genetic screening, artificial reproductive technologies (ART) were supported. In the UK parliamentary poll on many issues is preceded by studies and papers produced by agencies like Parliamentary Office on S&T while the European Parliament has Science and Technology Options Assessment (STOA) Unit to advice the parliament. In countries like Germany there are bodies like Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (TAB, the Office of Technology Assessment at the German Bundestag) that provide independent policy advice on S&T issues. According to Colin Macilwain (2014), developing S&T power horses like China, Brazil and India should build a more inclusive science to meet their societal needs by linking social sciences and natural sciences.

But in many developing countries like India and China this is not the case. In both countries the innovation discourse is the dominant discourse and S&T policies have objectives that are closely linked to national development, economic competitiveness, self-reliance and strategic interests. Hence, the S&T policy making process is more influenced and directed by actors and agencies who articulate the visions that imbibe such objectives. In India and China S&T is an integral part of policy making and Five Year Plans have separate S&T components and the broad thrust areas and priorities are identified in them. In case of

Box 2: S&T and Development Discourses in India

Scholars point out that in post-colonial societies science policy has become a key element in national developmental agenda.[13] In case of India the quest for a science policy resulted in debates as early as early 1930s and by the 1940s there was a broad consensus that free and independent India should utilise S&T for meeting developmental goals including aspirations of its citizens. While the official S&T policy discourse has been the dominant and driving discourse in S&T policy the other discourses have impacted the policy discourse in one way or other. The relationship between science and society in India has been discussed from different vantage points among scholars, activists and other stakeholders.[14] For the sake of analysis the discourses can be categorised into the following categories: (i) Nehruvian Discourse, (ii) Gandhian Discourse, (iii) Peoples' Science Movements and their discourse on S&T and (iv) Other Voices and Discourses on S&T.

There is overlap among these discourses and the important feature is that none of them display antagonism against S&T, nor posit that S&T is against the ethos of Indian civilisation. But they had distinct visions on role of S&T in development, the paradigms of growth and the paths to be chosen (Abrol 2012). The Nehruvian discourse is the dominant discourse and this has been the foundation of the official discourse of S&T, articulating a vision of using S&T for national development. In this S&T is both the cause and the effect in national development. In this discourse, the state plays the dominant role and sets the agenda on role of S&T in development. In the post-liberalisation India, STI is determined by state's policies, globalisation and private sectors role in R&D. Even now the dominant player in S&T is the state and its institutions while the contribution of private sector to R&D and innovation has increased. The official discourse, as reflected in the S&T and Innovation Policy, shows the changes in the expectations and roles.

The Gandhian discourse inspired by Mahatma Gandhi's vision of Swaraj and self-sufficient village communities gave importance to rural industries, small scale industries and agriculture that relies more on natural inputs. While J. C. Kumarappa envisaged limited use of fertilisers, he realised the importance of state's role in centralised provision of transportation and energy like electricity. State support for village industries was done through bodies like Khadi and Village Industries Commission (KVIC). The Gandhian discourse's influence waned by the 1960s yet ironically it inspired Schumacher and others to develop appropriate/intermediate technology paradigm as an alternative to dominant models of industrialisation. While A.K.N. Reddy and C.V. Seshadri were inspired by the ideas of Gandhi, they developed alternative technologies based on their experiences and needs of the communities. Institutions like the Center for Science for Villages and various organisations working on appropriate technologies continue in action the discourse inspired by Gandhi.

Peoples' Science Movements (PSM) articulated a vision rooted in the ideas of J. D. Bernal and other Marxist/Socialist thinkers and scientists and advocated using Science for Social Revolution. They agreed with the Nehruvian discourse in its vision on role of state in S&T but dissented in the priorities and programmes. Kerala Sastra Sahitya Parishad (KSSP) played an important role in opposition to Silent Valley Project which was abandoned on account of its potential negative impact on biodiversity. PSM engaged in science popularisation and wanted citizens to develop scientific temper and rational thinking. PSM echoed the traditional Marxist understanding of S&T in which the full realisation of S&T for the society is constrained by capitalism and policies that promote capitalism.

The other voices and discourses would include groups like PPST, scientists like D. D. Kosambi, A.K.N. Reddy, C. V. Seshadri and activists like Anil Agarwal, Vandana Shiva and various groups that questioned state policies regarding agriculture, forestry, large dams and energy. At different times they raised questions that impacted policy and civil society groups and movements continue to provide critiques on various development and S&T issues.

Source: Chaturvedi *et al.* (2014).

China there are special programmes in different sectors with specific mandates and funding for these programmes have helped China to make significant advances in many technologies including biotechnology. Elsewhere in Asia, where the hands of the developmental state not only point the direction but also set the objectives, they have had significant impacts

[13] Salami and Soltanzadeh (2012).

[14] See Sujatha and Sengupta (2013) for details.

in S&T policy. Thus, the experience in India and China indicates that S&T policy process has provided little scope for other voices and discourses and social-ethical analysis has not been given the importance that it deserves. This 'Business As Usual' approach is not the right approach, given the challenges in governance of emerging technologies and globalisation of S&T.

However, this is changing, as is evident in the Science, Technology and Innovation Policy of India and in the initiatives taken by Chinese Government to assess public opinion and perception and also the increase in importance given to ELS issues in S&T policy. Mainstreaming social-ethical analysis does not mean that India should replicate structures and processes that are found in Europe or the USA, nor does it mean that it should adopt the same policies for mainstreaming. Mainstreaming social-ethical analysis is possible and will be considered desirable only when such mainstreaming is not perceived as a counter-narrative to the innovation discourse. Mainstreaming as a process will take time to form roots and expand. Hence, the modalities of mainstreaming have to develop taking into account the S&T context in India and the relationship between S&T and society and the diversity in stakeholders.

India established an agency for technology assessment and forecasting (TIFAC) in early 1990s. Institutions in India have significant strength in undertaking social science research in social-ethical analysis. Scientific bodies and organisations of scientists have often displayed their interest in understanding the social-ethical implications and on issues in science, technology and society. With policymakers acknowledging the importance of understanding social-ethical implications, the modalities of mainstreaming can be developed by involving social scientists, scientists, technocrats and other stakeholders including academies of science. To begin with, the role of TIFAC can be expanded and its mandate can be broadened to include social-ethical analysis. TIFAC's capacity should be strengthened in both forecasting and assessment. Similarly, Department of Science and Technology (DST) should expand its work on science and society and on measuring innovation. Systematic surveys on public perception and understanding have to be done. Right now there is capacity within CSIR system in the form of NISTADS and other institutions while DST has sponsored Vigyan Prasar for science popularisation. In the framework we are suggesting that there is scope for them and also for new initiatives.

The lack of space for other voices and narratives is a serious issue and this has to be addressed by providing space for other voices and narratives and by involving stakeholders in consultations and through process of dialogue, confidence between the other actors and policymakers can be built. Science academies, universities and publicly funded institutions can act as bridges between policymakers and those who do social-ethical analysis and those who represent the other voices. Thus, mainstreaming can be achieved by giving importance to modalities, institutionalising and through mutual learning.

Conclusions and Suggestions

In the context of Global Ethics in S&T Project, RIS went beyond the traditional perspectives on ethics in S&T policy and formulated AEI as the norms that are more relevant in the Indian context. This idea has to be developed further, in both theory and measuring it. This calls for research in developing indicators for assessing impacts through AEI. As economic growth by itself does not ensure AEI in outcomes, special programmes and efforts are needed to ensure that they are reflected in the outcomes. The experiences of the states provide a framework for comparative analysis for inferring the features of policies that lead to better AEI.

DST is sponsoring programmes for social empowerment and promoting equity. These programmes can be evaluated using AEI norms. In this, the challenge is two fold – one is to revise and improve the current indicators and the other is to develop indicators that could measure AEI and open up space for policy interventions. Studies have focused on evidence from technological innovations best suited for development challenges, legal and social norms

to support innovation and inclusion and access within the ambit of S&T decision making for various stakeholders. In this regard, we call for a wider debate on socio-economic (SE) assessment of S&T policies and projects and stress that SE assessment should go beyond typical Cost-Benefit Analysis or technology assessment.

In case of emerging technologies traditional approaches to S&T policy making can be supplemented by using ideas like anticipatory governance and risk governance. These ideas have practical consequences and there is need to explore how to apply these ideas in the Indian context.

We suggest that research on Access, Equity and Inclusion and Ethical, Legal and Social Issues in S&T should be given more importance. Such research should become part of the S&T policy process and major technology initiatives and policy proposals should allot 3 to 5 per cent of the proposed budgets to such research. In case of Mission Mode programmes like Nano-mission AEI research should be initiated in the beginning itself. The Ethical, Legal and Social Issues (ELSI) research should be undertaken on a broad scale involving institutions outside ministries and departments and should involve institutions that represent stakeholders. India should propose a network of institutions in developing nations working on AEI issues and S&T policy issues and this can be integrated with multilateral S&T collaboration framework. This will enable developing a 'Southern' approach in AEI issues and will strengthen the capacity in S&T policy making in developing nations. ELSI research will be useful in avoiding unnecessary controversies and inspire confidence in S&T among the public and also help the policymakers to identify potential negative impacts and issues in public perception of and response to risks and benefits from S&T. In fact the Human Genome Project is the first project in the USA in which a specified percentage of funding was allocated to researching Ethical, Legal and Social Issues.

Public engagement with S&T should be promoted and the top down science communication model should be revisited and revised. More studies on public perception of S&T, public perception of risks and benefits of specific technologies should be undertaken. Identifying the values and beliefs held by public that impact their perception and response to S&T is important. Surveys and other means of identifying them can be conducted on a regular basis. This will be useful in efforts in science popularisation and science communication. These exercises can be made part of capacity building in S&T policy making.

We hope that the findings from AEI, as outlined above, will be relevant to S&T policy making and would generate enough interest to bridge the gap between 'two cultures', i.e. S&T and social sciences.

References

Abrol, D. 2012. "Pro-poor Innovation-making: Critical Reflections on the Indian Experience." Paper presented at the first CDEIS-Indialics International Conference on Development and Innovations in the Emerging Economies held at Punjabi University, Patiala on 16–18 November 2012. Available at: http://www.punjabiuniversity.ac.in/cdeiswebsite/papers/8%20Dinesh%20Abrol%20PAPER%20for%20Lakhvinders%20Nov%2016%20Workshop%20in%20Patiala.pdf

ADB. 2011. *Framework of Inclusive Growth Indicators.* Asian Development Bank (ADB), Manila.

Bozeman, B., C.P. Slade, and P. Hirsch. 2011. "Inequity in the Distribution of Science and Technology Outcomes: A Conceptual Model". *Policy Sciences,* 44 (3):231–248.

Cozzens, S.E., and J. Wetmore (ed.) 2011. *Nanotechnology and the Challenges of Equity, Equality, and Development.* New York: Springer.

Cozzens, S.E. 2007. "Distributive Justice in Science and Technology Policy." *Science and Public Policy,* 34 (2):85-94.

Chataway, J., Rebecca Hanlin and Raphael Kaplinsky. 2013. "Inclusive Innovation: Architecture for Policy Development." *IKD Working Paper No. 65.* Innovation, Knowledge, and Development (IKD), The Open University, UK.

Chataway, J., Rebecca Hanlin and Raphael Kaplinsky. 2014. "Inclusive Innovation: An Architecture for Policy Development." *Innovation and Development,* 4(1) pp. 33–54.

Chaturvedi, Sachin, Krishna Ravi Srinivas and Rashmi Rastogi. 2014. "Science, Technology, Innovation" in *India and Access, Inclusion and*

Equity: Discourses, Measurement and Emerging Challenges (mimeo). RIS, New Delhi.

DST. 2013. *S&T and Innovation Policy.* Department of Science and Technology (DST), New Delhi.

DST. 2010. *India as a Global Leader in Science.* Science Advisory Council to the Prime Minister. Department of Science and Technology (DST), New Delhi.

European Commission. 2009. *Global Governance of Science.* A Report of the Expert Group on Global Governance of Science to the Science, Economy and Society Directorate, Directorate-General for Research. European Commission, Brussels.

Eurostat. 2013. "The Measurement of Poverty and Social Inclusion in the EU: Achievements and Further Improvements." *Working Paper 25.* United Nations Economic Commission For Europe.

Gault, F. 2011. "Social Impacts of the Development of Science, Technology and Innovation Indicators." *UNU-MERIT Working Papers* 2011-008. United Nations University – Maastricht Economic and social Research and training centre on Innovation and Technology (UNU-MERIT), Maastricht.

Gault, F. (ed.). 2013. *Handbook of Innovation Indicators and Measurement.* Cheltenham: Edward Elgar.

Hall, J., S. Matos, and C.H. Langford. 2008. "Social Exclusion and Transgenic Technology: The Case of Brazilian Agriculture." *Journal of Business Ethics,* 77 (1): 45–63.

Hennen, Leonhard. 2012. "Why Do We Still Need Participatory Technology Assessment?" *Poiesis Prax,* 9:27-41.

Jospeh, K.J., L. Singh, and V. Abraham. 2014. "Dealing with the Innovation–Inequality Conundrum: The Indian Experience" in Maria Clara Couto Soares, Mario Scerri and Rasigan Maharajh (eds): *Inequality and Development Challenges*. London: Routledge, pp. 149-189.

Macilwain, Colin. 2014. "Emerging Powers Need a More-inclusive Science." *Nature,* Vol. 505: 7.

Mercado, A. 2012. "Social Inclusion or Social Illusion: The Challenges of Social Inclusion, Social Participation and Social Cohesion in Venezuelan S&T Policy." *Science and Public Policy,* 39 (5): 592-601.

OECD. 2014. *Science, Technology and Industry Outlook 2014.* Organisation for Economic Co-operation and Development (OECD), Paris.

Rip, Arie and Haico te Kulve. 2008. "Constructive Technology Assessment and Sociotechnical Scenarios" in Erik Fisher, Cynthia Selin and Jameson M. Wetmore (eds): *The Yearbook of Nanotechnology in Society*, Volume I: Presenting Futures. Heidelberg: Springer.

Ronald, Labonté, Abdullahel Hadi and Xaxier E. Kauffmann. 2011. "Indicators of Social Exclusion and Inclusion: A Critical and Comparative Analysis of the Literature." *Working Paper Series,* Vol. 2 , No.8. Globalization and Health Equity Research Unit, University of Ottawa.

Salami, R., and J. Soltanzadeh. 2012. "Comparative Analysis for Science, Technology and Innovation Policy: Lessons Learned from Some Selected Countries (Brazil, India, China, South Korea and South Africa) for Other LDCs like Iran". *Journal of Technology Management Innovation*, 7 (1):212-227.

Schwachula, Anna, Maximiliano Vila Seoane and Anna-Katharina Hornidge. 2014. "Science, Technology and Innovation in the Context of Development." *ZEF Working Paper No. 132.* Center for Development Research, University of Bonn, Bonn.

Sujatha, V. and Anubhav Sengupta. 2013. "Knowledge, Science, and Society" in Y. Singh (ed.): *Indian Sociology: Emerging Concepts, Structure, and Change,* Vol. 3. New Delhi: Oxford University Press.

UNCTAD. 2014. *Innovation Policy Tools for Inclusive Development.* United Nations Conference on Trade and Development (UNCTAD), Geneva.

UNDESA. 2010. *Analyzing and Measuring Social Inclusion in a Global Context.* United Nations Department of Social and Economic Affairs (UNDESA), New York.

World Bank. 2013. *Inclusive Innovation for Sustainable Inclusive Growth.* World Bank, Washington DC.

World Bank. 2013. *Inclusion Matters: Foundations for a Shared Prosperity.* World Bank, Washington DC.

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