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Rural Women's Access to Science and Technology in the Context of Natural Resource Management¹

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Science and technology (S&T) is a broad term that is in a continual process of reinvention. Many of the S&T breakthroughs of 20 or 30 years ago are part of everyday life today. Rural women in most parts of the world have also benefitted, especially through greater access to information. Science and technology offers solutions to many challenges faced by rural women including labour-saving technologies related to domestic and productive work such as water pumps and community water schemes, improved cooking technologies, transport of water, wood and crops, post-harvest and food processing. However, because of women's lower education levels, their lesser access to credit, their lack of land tenure and other discriminatory practices, men are most frequently the beneficiaries of new and improved agricultural technologies.² The poorest women continue to use labour-intensive traditional technologies or use no technologies at all.

Many new and emerging technologies hold good potential for women's empowerment but not all address gender differences adequately. More thorough analysis is needed about their effects on poor women and men in agriculture. It is clear that lessons can be learned from the experiences gained in the last 30 years with the differential impact of the older, basic technologies on women

¹ This paper is based on earlier work done for FAO and IFAD. The author gratefully acknowledges their support.

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² Carr, Marilyn with Maria Hartl. **Lightening the Load. Labour saving technologies and practices for rural women.** IFAD and Practical Action Publishing. 2010.

versus men and rich versus poor. Past experience shows that technologies must be introduced with a good understanding of local economic conditions and cultural practices. New agricultural technologies can work against the immediate interests of women. There is also a strong argument to be made for the introduction of technologies that will help poor households to cope with increasing climate variability and long-term climate change, to improve crop yield and to reduce time spent on laborious agricultural tasks and to ensure that women and men can cope with changes in their environments.³

A brief review of recent literature on gender and science and technology in rural areas has identified a number of consistent findings. They are presented below not as a conclusive statement on gender, S&T but as a reflection of current thinking. The findings have been organized into 13 general points that cover both the content of improved agricultural productivity and methods used to ensure greater inclusiveness and gender equity.

1. Gender roles in agricultural production change in response to economic and social conditions.

Although many cultures and/or societies have traditionally assigned some agricultural tasks to men and others to women, the boundaries have eroded as a result of migration, armed conflict, HIV and AIDS and other intervening factors. In some cases this has placed a heavier work load on women as they have had to assume work formerly done by male family members.⁴ In other cases, at peak periods when there is need for additional labour, men have helped women in tasks that were traditionally performed by females. Female-headed households are often the least able to mobilize additional labour when it is needed, because they tend to be poorer and have fewer resources to pay for labour.⁵

2. Technology adoption rates of male and female farmers are impacted by the different conditions under which they operate, including access to resources, secure land tenure, etc.

Some researchers have suggested that women adopt technologies more slowly than men but others have found that women's adoption rates are affected by their specific needs and their access to resources. Researchers in Zimbabwe found that households with female labour constraints were less likely to adopt improved fallow technology⁶ and in Kenya they were less likely to adopt expensive technologies like inorganic fertilizer.⁷ However a study of male and female farmers in Malawi concluded that women farmers were quicker to adopt a new kalmia

³ Lambrou and Nelson. 2010. *Farmers in a Changing Climate: Does Gender Matter ?*. FAO, Rome.

⁴ Abdelali-Martinia Malika, Patricia Goldey, Gwyn Jones, and Elizabeth Bailey. Towards a Feminization of Agricultural Labour in Northwest Syria. **The Journal of Peasant Studies**, 30, 2 (Jan 2003): 71-94

⁵ Doss, Cheryl R. Designing Agricultural Technology for African Women Farmers: Lessons from 25 Years of Experience. **World Development** 29,12 (December 2001): 2075-2092.

⁶ Mudhara, M, P.E. Hilderbrand and P.K.R. Nair. Potential for adoption of *Sesbania sesban* improved fallows in Zimbabwe:A linear programming-based case study of small-scale farmers. **Agroforestry Systems** 59 (2003): 307–15.

⁷ Marenya, Paswel P. and Christopher B. Barrett. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in western Kenya. **Food Policy** 32 (2007): 515–36.

bean variety because it had qualities that they valued, such as a shorter cooking time and a good taste.⁸ In Vietnam, an IFAD project found that although male and female farmers both wanted high yielding and high value rice varieties, men were equally concerned with pest resistance while women placed greatest value on the characteristics associated with easier post-harvest processing and taste.⁹

In India, attitudes of men and women towards the adoption of groundnut production technology differed along gender lines. While men were mostly concerned about financial viability of the technology, women perceived the advantage of the new technology options in terms of workability and implications for drudgery and occupational hazards.¹⁰

3. New technologies can have uneven impact on women's labour burdens.

In India, the adoption of high-yielding varieties of rice and wheat after the Green Revolution was disadvantageous for many of the poorest women from landless or near landless households. Insufficient employment was generated to include all who needed work and wages remained low. Women were paid less than men and were given the more labour-intensive tasks of weeding, transplanting and harvesting.¹¹ On the other hand, in Padulara, India the introduction of Green Revolution technologies (high yielding varieties of seed, use of fertilizers, pesticides, agricultural machinery, controlled water supply, etc.) led to an increase in agricultural production over time and families with larger land holdings began to prohibit female members from working on the land. For families with smaller land holdings, the increased productivity in the region created new sources of agricultural employment for women who were hired out as contract labour.¹² In South and Southeast Asia, the introduction of drum seeders in rice cultivation saved time and labour for wealthier farmers but it removed traditional jobs from the poorest and landless women.¹³

Mechanization of agriculture is becoming increasingly common, especially in Asia, however women are often prohibited from using such machinery because of prevailing cultural practices. Mechanization can also have an adverse impact on female employment opportunities. In Bangladesh in the 1980s, about 100,000 women per year were displaced after the introduction of rural rice mills.¹⁴ In India, when a mussel farming project wanted to introduce semi-automated seeding machinery, poor women who worked as occasional labourers in manual seeding, were apprehensive that they would lose their jobs¹⁵.

⁸ Masangano, C.M. and C. A. Miles. Factors Influencing Farmers' Adoption of Kalima Bean (*Phaseolus vulgaris* L.) Variety in Malawi. **Journal of Sustainable Agriculture** 24, 2 (2004).

⁹ IFAD, Technical Assistance Grant No. 424 for IRRI, Bangladesh, India, Vietnam, Sri Lanka and Thailand, 1999-2004.

¹⁰ Padmaja, Ravula Padmaja and Ma Cynthia Serquina Bantilan. Gender Issues in Aquaculture: Learning lessons from the International Crops Research Institute for the Semi-Arid Tropics. **Development** 51(2008): 271-77.

¹¹ FAO Focus. Women and Food Security. n.d. <http://www.fao.org/focus/e/women/green-e.htm>

¹² Samaddar, Arindam and Prabir Kumar Das. Changes in transition: technology adoption and rice farming in two Indian villages. **Agriculture and Human Values** 25 (2008):541-553

¹³ Carr and Hartl. 2010.

¹⁴ Carr, Marilyn with Maria Hartl. **Lightening the Load. Labour saving technologies and practices for rural women.** IFAD and Practical Action Publishing. 2010.

¹⁵ Kripa, Vasanth and Vazhoor Gopalan Surendranathan. Social Impact and Women Empowerment through Mussel Farming in Kerala, India. **Development** 51(2008):199-220

One positive benefit of new labour saving technologies in the domestic/reproductive sphere is that they can free women's time to allow them to work on irrigated plots or invest in other types of technology that will bring economic benefits. For example, in a rice cultivation area of Senegal, technologies such as improved wood stoves and grain processing machinery had the potential to reduce women's domestic labour and free them to work on irrigation plots. However, adoption of the domestic labour saving technologies involved a decision about capital investment.¹⁶ Since women often have little voice in household finances, their needs for such technologies may not be prioritized.

4. More technology research is needed on commodities and production processes dominated by women.

Most agricultural researchers do not give attention to gender analysis in technology development. This lack of gender sensitivity also affects the research topics they chose. For example, women are often deeply involved with vegetable cultivation in kitchen gardens. Vegetables contribute to household food security, have important nutritional benefits and often are sold in local markets to generate cash incomes. However, vegetable production is given little attention by agricultural researchers. There is a need for NGOs, and researchers to study the value of such plants, promote and valorize the production and consumption of the highly nutritious or medicinal plants, whether through markets or direct consumption.¹⁷ A study of poor households in a rice growing region in Senegal found that on average, women's contribution to livelihoods in poor households was over half a poor household's average rice earnings. A substantial proportion of this income came from vegetable farming.¹⁸

5. Farmers' groups are effective in disseminating new technologies.

Farmers' groups are effective in disseminating technologies, building a sense of shared purpose, and enabling cooperative action in sustainable natural resources management and development. In Uganda, researchers found that although male participation in a farmers' research group was high at the outset, men tended to drop out while women remained. However, men still held the executive positions in the groups (with the exception of treasurer). The study also found that although there were no exclusively male farmers' groups, there were many exclusively female groups. Wealth of the farmers did not appear to be a limiting factor for women to joining farmers' groups and over time female members often gained self-confidence and began to speak out.¹⁹

¹⁶ Nation, Marcia. Understanding women's participation in irrigated agriculture: a case study from Senegal. **Agriculture and Human Values** 27, 2 (June 2010):163-76 .

¹⁷ Meizen-Dick, Ruth, Agnes Quisumbing, Julia Behrman, Patricia Biermayr-Jenzano, Vicki Wilde, Marco Noordeloos, Catherine Ragasa, Nienke Beintema. Engendering Agricultural Research. Paper prepared for Global Conference on Agriculture and Rural Development Montpellier, France ,28-31 March, 2010.

¹⁸ Koopman, Jeanne E. Globalization, Gender, and Poverty in the Senegal River Valley. **Feminist Economics** 15, 3(2009): 253-85.

¹⁹ Sanginga, Pascal C., Jackson Tumwine and Nina K. Lilja. Patterns of participation in farmers' research groups: Lessons from the highlands of southwestern Uganda. **Agriculture and Human Values** 23, 4(December 2006): 501-12

In India, uptake of groundnut production technology was accelerated through the formation of kinship and formal networks, farmers' groups and self-help groups among small- and medium-scale land-holding farmers, landless and tribal women. Common constraints such as access to information and credit and inputs like seed and gypsum fertilizer were overcome through group action.²⁰

6. Agricultural extension is still an important driver in technology introduction and adoption.

Agricultural extension continues to play a key role in technology dissemination. Over the years, extension methods have moved towards more participatory approaches and increasingly they make use of communication technologies.²¹ However, some national systems are still gender insensitive. For example, in rural Zimbabwe, despite a large proportion of female-headed households, only 10 percent of women farmers participate in agricultural extension training.²² Research with rice farmers in South and Southeast Asia found that most extension agents interacted only with men so women did not receive important information and were unable to take advantage of opportunities such as the chance to earn income from renting out drum seeders.²³ Research in Tanzania found that many women farmers preferred to interact with female extension officers because they thought that they could discuss their problems with them. Some men also preferred female extension officers and others had no preference as to male or female officers.²⁴ A study in Kenya found that previous awareness and adoption of technology by farmers of the same sex increases the probability of adoption, especially for female farmers.²⁵

There have been some successful efforts to institutionalize extension to female farmers. For example, Nigeria has established Women in Agriculture Units with female extension staff throughout the country. These units identify the information and technical needs of rural women and provide training and technology dissemination, working through local women's groups.²⁶

7. The indigenous S&T knowledge of poor farmers, both male and female, should be integrated into strategies for introducing new technologies.

Agricultural research is often carried out without attention to the existing technical knowledge held by male and female farmers. Most "indigenous" or "traditional" knowledge is based on

²⁰ Padmaja and Bantilan. 2008.

²¹ For example, the Information Village project of the M.S. Swaminathan Foundation in India has set up village knowledge centres that are connected electronically and share farming information both electronically and through more traditional means. Women are fully integrated, both as knowledge managers and users.

²² Ponniah, Anandajayasekeram, Ranjitha Puskur, Sindu Workneh and Dirk Hoekstra. **Concepts and practices in agricultural extension in developing countries: A source book.** ILRI (International Livestock Research Institute).2008.

²³ IFAD, Technical Assistance Grant No. 424 for IRRI, Bangladesh, India, Vietnam, Sri Lanka and Thailand, 1999-2004.

²⁴ Due, Jean M. ,Flavianus Magayane and Anna A. Temu. Gender Again -Views of Female Agricultural Extension Officers by Smallholder Farmers in Tanzania. **World Development** 25, 5 (1997).

²⁵ Quisumbing and Pandolfelli. 2010.

²⁶ Ponniah, Puskur, Workneh and Hoekstra. 2008.

generations of experience and field testing. Many poor women and men have complex practical understanding of agriculture, fisheries, horticulture, forestry and health. These knowledge systems are gradually being eroded. The breakdown of such traditional and indigenous rights regimes is leading to the loss of plant biodiversity and new intellectual property rights regimes tend to assign intellectual property rights and benefits to groups of male community members.²⁷

The technical knowledge of men and women in rural communities is usually based on the work that they do. Women are particularly knowledgeable about seed diversity and plant breeding since they often have responsibility for collecting and storing seeds from one season to the next. They also have knowledge of local biodiversity and sometimes use their home gardens to experiment with gathered species and tree products.

8. Participatory research methods alone are not sufficient to guarantee self-sustained adaptation of new technologies.

Participatory approaches for the dissemination of S&T have been widely used by some researchers and agricultural extension systems. Such methods often involve farmers in problem analysis, determination of extension priorities, and in extension planning. Sometimes farmers also provide feedback to extension activities and/or new technologies, conduct small-scale experimentation and/or participate in on-farm experiments. They may be involved in monitoring and evaluation and they may participate in or organize networking and information exchange fora. However, many participatory efforts have worked with “the community” without recognizing that this may consist of richer male farmers while the poor and/or female farmers are left out.

Lilja and Ashby developed a framework to measure process impacts, technology impacts and cost impacts within a gender/stakeholder analysis. They point out that “participation” as used by agricultural scientists can range from merely informing farmers of research plans to active farmer experimentation.²⁸ Gender sensitive participatory methods can be important mechanisms for introducing new technologies to women but they are not sufficient to guarantee self-sustained adaptation of new technologies. Empirical testing methods also provide important information for policymakers.²⁹ There has been little systematic analysis of the impacts of participatory methods for gender-sensitive technology adoption versus alternative approaches to adoption.³⁰

9. Gender mainstreaming into technical knowledge dissemination can help to ensure that women benefit

FAO and IFAD have worked with government ministries and national extension systems to help them mainstream gender into their programs. They have been active in promoting institutional

²⁷ Howard, P.L. and G. Nabanoga. Are there Customary Rights to Plants? An Inquiry among the Baganda (Uganda), with Special Attention to Gender. *World Development* 35, 9 (September 2007):1542-63.

²⁸ Lilja, N., J. Ashby, L. Sperling and A.L. Jones, eds. **Assessing the impact of Participatory Research and Gender Analysis**. CGIAR-PRGA. 2001.

²⁹ Gladwin, Christina H., Jennifer S. Peterson, and Abiud C. Mwale. The Quality of Science in Participatory Research: A Case Study from Eastern Zambia. *World Development* 30, (2002):523–43.

³⁰ Quisumbing and Pandolfelli. 2010

reform as a vehicle towards the economic empowerment of rural women and giving them a greater role in decision making at all levels. They have also worked with local governance structures, helping to ensure that the voices and concerns of the poor are heard in decision-making processes.

In Ecuador, FAO mainstreamed gender analysis into technical knowledge and enhanced the gender analytical capacity of national experts working for the development of rural agriculture and food security.³¹ In Asia and Africa, FAO increased women's access to productive resources and appropriate irrigation technologies by working with national experts from 21 countries, introducing low cost and water- saving technology for irrigation crop production.³² They were given training in gender analysis and participatory tools to more actively involve women and poorer farmers in water management. IFAD has also been active in mainstreaming gender into technical knowledge and in ensuring that women have access to technical training. For example, a program in Nepal, done jointly with the International Labour Organization (ILO), is helping conflict-affected youth, including ex-combatants, reintegrate into their communities by providing training and skills enhancement in sub-sectors where opportunities for future employment exist.³³

10. Successful participation in technology transfer projects has positive benefits in raising the self- confidence of rural women.

Access to technology and improvement of farming and production systems can have positive benefits not only from an economic perspective but also in helping to enhance the status of women. Research in Uganda suggested that over time female farmers became more confident about speaking up in public meetings.³⁴ However, women farmers who successfully use new technologies and improve their socioeconomic status may also experience increased tension if husbands or community members have negative reactions to their new status.³⁵ In some cases, women risk losing control over their crops as their production systems become more successful.³⁶ In Kenya, men began to use banana tissue culture biotechnology after women farmers had pioneered the process with researchers and had substantial increase in yields and increased their incomes.

11. Gender responsive approaches to technology transfer can have a high level of uptake.

A recent FAO/ IFAD study that investigated the linkage between water and rural poverty in sub-Saharan Africa concluded that there are ample opportunities to invest in water in support of rural

³¹ 2003. *Fortalecimiento de los sistemas de conocimiento e información para el desarrollo rural – Project Document*. [TCP/ECU/2902]

³² 2004. *Gender analysis in farmers' water management – Terminal Report*. GCP/INT/872/ITA

³³ IFAD (2007 a), Country-specific grant to the International Labour Organization for the Skills Enhancement for Employment Project in Nepal, EB 2007/92/R.40.

³⁴ Sanginga, Jackson and Lilja. 2006.

³⁵ Gurung, Chanda and Scott E. Justice. Empowerment of Women through external (Project) intervention: Case Study of women two-wheel tractor operators. N.d. http://www.wocan.org/document_pdfs/IDP46a767c38b14a.doc

³⁶ Quisumbing and Pandolfelli. 2010

livelihoods, but that interventions must be well targeted.³⁷ A comprehensive approach is needed in which investments in infrastructure are matched with interventions in institutions, knowledge and finance to offer the best return in poverty reduction. The Multiple Water Use (MUS) approach is promising, as multi sectoral infrastructure systems address broad water needs better than sectoral water development programmes.³⁸

12. Improved rural communications can accelerate technology dissemination to poor men and women.

Information communications technologies (ICTs) have become a central part of rural development. The rapid growth of mobile phone coverage and mobile phone users in developing countries has created new opportunities for poor women and men to access information and technologies in a timely, cost effective manner. A wide range of applications and services are becoming available in many countries. For example, in Bangladesh, women poultry farmers are using their mobile phones to make direct contact with final buyers, thus eliminating the role of the middleman plus gaining direct information about market preferences. Research in India showed that mobile phones increase women's economic independence as they are worth the equivalent of two to four extra years of education in terms of reducing gender inequalities.³⁹ In Tanzania⁴⁰, the *shu shu shu*, a type of "market spies", investigate prices and information in the local markets and use their mobile phones to report back to their villages.

13. Green technologies are becoming increasingly important.

Renewable energy is often cited as a key mitigation technology for climate change. Increased attention is being given to the use of biofuels which have long been used as an energy source by women in areas with sparse forest resources. The growing emphasis on biofuels has implications for women in developing countries both because there is increased competition for available biofuels and because sizable amounts of fertile agricultural land formerly used for food production is being diverted to growing biofuels (*e.g.*, maize, sugar cane, etc.). Energy crop plantations typically require large amounts of water and often draw on local water sources that are already meagre. As a result, women have to spend even more time and energy in collecting water for household needs while they do not necessarily benefit from the proceeds of plantation energy crops.⁴¹ Traditional biomass fuels such as wood, charcoal and agricultural residues are usually managed by women and often represent a high proportion of national energy supplies. In Sub-Saharan Africa they constitute about 50 percent of primary energy consumption. Identifying appropriate alternative energy sources is not only important for the environment, it is also key to reducing women's workloads.

³⁷ www.fao.org/docrep/010/i0132e/i0132e00.htm.

³⁸ Quisumbing and Pandolfelli. 2010

³⁹ IFAD, Rural Poverty Report 2011

⁴⁰ IFAD, Agricultural Marketing Systems Development Programme, Tanzania

⁴¹ Rossi, A. and Lambrou, Y. (2008). **Gender and equity issues in liquid biofuels production. Minimizing the risks to maximize the opportunities.** Italy: FAO. Rathgeber, Eva. Module 6: Gender-sensitive strategies on technology development and transfer to support actions on mitigation and adaptation. In **Training Manual on Gender and Climate Change.** IUCN, UNDP, GGCA. 2009.

Strategies for improving women's access to and participation in science and technology

The findings discussed above are not particularly new. They capture points that have been made repeatedly by scholars and gender analysts. The critical question then becomes: why have these findings, which are supported by research and by practical field experience, not been given greater attention by agricultural development planners, international organizations that support agricultural development and agriculture researchers?

Providing poor women with better access to science and technology is only one piece of a much larger puzzle. If women do not have equal access to credit, to land, to education, to extension services, etc. then access to science and technology is unlikely to have a major impact on improving their livelihoods. There is need for serious commitment to gender equality on the part of world governments if women are to achieve parity with men in the rural sector.

The following are a few key areas where governments should make investments. There have been many previous lists of potential interventions to accelerate gender equality, not only in agriculture but in all aspects of social, economic and political life. The objective here is not to provide another long list of possible interventions but to address the need for an enabling environment for gender and S&T.

Policy

- Women are central actors in food production and governments must facilitate the work of poor farmers, including female farmers. Governments can play a major role in changing traditional mindsets that stereotype women into secondary positions. Gender mainstreaming in agricultural ministries and research institutions should not be voluntary or donor-driven. Governments should make it a compulsory strategy to improve their own potential to meet food security needs.

Education/Training

- Education should be seen as life-long for everyone, including poor men and women in the rural sector. Governments have an important role in convincing conservative or traditional populations that acquisition of new skills and technologies is a normal part of life. Adult education, through agricultural extension programs, and through mass communications should be hands-on and innovation should be recognized and valued.

Women's Knowledge

- Women's traditional knowledge often is based on years of observation and experimentation. It should be seen as a starting point for the introduction of new technologies. Research should be seen as a two-way process with learning on the part of both the researchers and the farmers.

This Rural Development and Natural Resource Management programme from Swedish University of Agricultural Sciences offers students knowledge and skills from different disciplines - with a key theoretical base in the social sciences - to create appropriate ways of managing rural problems in context. Students are taught how to facilitate and manage developmental projects and to acquire knowledge and skills in conducting research. The courses will provide theoretical knowledge applied in case study scenarios, requiring active student involvement. In book: *Managing Natural Resources for Development in Africa*, Edition: 1st Edition, Chapter: 6, Publisher: University of Nairobi Press (UoNP) and International Institute of Rural Reconstruction (IIRR), Editors: Washington O. Ochola; Pascal C. Sanginga and Isaac Bekalo, pp.54. Cite this publication. P.Z. Yanda. Conflicts Management in Community Based Natural Resource Management .187. Role of Indigenous Knowledge in CBNRM .192. Summary.202. Figure 5.5: Access and Control Profile for Camel Resource among the Rendile in Kenya .240. Figure 6.1: Global Mean Surface Temperature Difference Relative to the 1961. Natural Resource ManagementIntroductionNatural resource management refers to strategies intended to sustain both renewable and non-renewable resources for present and future use. By considering how best to use the particular resource, its productivity is prolonged, and its relationship with the environment is protected. Science and Technology. Social Sciences and the Law. Sports and Everyday Life. One example of natural resource management could include the efforts of a number of organizations to preserve water availability and quality around the world. Management of water is becoming especially important as regions of the globe become warmer and drier under the influence of global warming.