Environmental technology diffusion in developing countries

The roles of different actors in the transition to a sustainable society

Saskia Manshoven

Study commissioned by the European Commission, DG Environment (ENTR/29/PP/2010/FC)
In collaboration with project partners: IDEA Consult, VITO, DTI, REC, Ecorys-UK
Technological innovation in developing countries

75% of world population has access to a mobile phone  
(World Bank, 2012)

Innovation = something new to a local context
Limits to leapfrogging

She lives on less than $1.25 a day.

SURVIVE125.ORG
Can you?
Technology diffusion models: S-curve

- *Epidemic* or *rational choice* diffusion models: quasi-automatic process?
  - Infectious
  - Rational, fully informed actors
  - Profit maximisation

- Competition?
- Regime conditions?
- Clean technologies?
Technology diffusion models

» **Evolutional** diffusion model – Transition management
  » Landscape and niche pressure
  » Competition with established and new technologies
  » Regime constraints
  » Windows of opportunity
  » Feedback and adaptation

» Which factors determine whether a technology breaks through?
Technological innovation system

“a network or networks of agents interacting in a specific technology area under a particular institutional infrastructure to generate, diffuse and utilise technology” (Carlsson-Stankiewicz)
Technological innovation systems: key functions

What are the soft conditions that stimulate technology diffusion?

- Entrepreneurial experimentation
- Knowledge development (learning)
- Knowledge diffusion through networks
- Guidance of the search
- Market formation
- Resource mobilisation
- Creation of legitimacy

Which actors fulfill a role in which function?

Virtuous / Vicious cycles

Hekkert, Negro: Technological forecasting & Social change 74 (2007) 413-432
Case study: Nepal Biogas Support Program

SNV

Summary
Total No of Plants under BSP: 225,356
Total No of Plants under GSP: 5,874
Total: 231,230
Total Number of Districts Reached: 75
Total Number of VDCs Reached: 2,769

Manandhar, 2011

Consolidation and commercialisation
Market expansion
Technology development and introduction

Budget (US$):
Pre-BSP stage 9.5 mio 21.8 mio 8.7 mio + 5 mio 171 mio
BSP I and II 13.200 + 100.000 + 200.000
BSP III
BSP IV
RREP
Case-study biogas in Nepal: institutional set-up

NGO

SNV

BSP

PUBLIC

AEPC

International development funding

Government of Nepal

PRIVATE

NBPA

MFI

Promotion partners

PRIVATE

Banks

Biogas companies

Nepalese farmer
## Case study: biogas in Nepal: function matrix

<table>
<thead>
<tr>
<th>Innovation system functions</th>
<th>Public sector (host)</th>
<th>Public sector (donor)</th>
<th>Private sector</th>
<th>Civil society, intermediaries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Government of Nepal AECP</td>
<td>DGIS-KfW</td>
<td>Biogas companies Banks, MFI</td>
<td>SNV, NBPA, BSP-Nepal</td>
</tr>
<tr>
<td><strong>Entrepreneurial experimentation</strong></td>
<td>• set up of test station</td>
<td></td>
<td>• organisation of private companies in an association</td>
<td>• Capacity building of the private sector (business &amp; management training)</td>
</tr>
<tr>
<td><strong>Knowledge development (learning)</strong></td>
<td>• set up of test station and information center, coordination of R&amp;D</td>
<td>• Technical assistance through SNV</td>
<td>• Continuous R&amp;D efforts to optimise design • standardisation</td>
<td>• Strengthen the capacities of all key stakeholders</td>
</tr>
<tr>
<td><strong>Knowledge diffusion through networks</strong></td>
<td>• set-up of coordinating institutions • strategic partnerships between different sectors</td>
<td></td>
<td>• organised in sector organisation (NBPA)</td>
<td>• Programme is coordinated by multiple actors</td>
</tr>
<tr>
<td><strong>Guidance of the search</strong></td>
<td>• strict enforcement of quality standards • support and setting of goals</td>
<td></td>
<td></td>
<td>• develop an effective quality control mechanism</td>
</tr>
<tr>
<td><strong>Market formation</strong></td>
<td>• Design financial incentives</td>
<td>• Avoid charity and dumping practices</td>
<td>• Avoid unhealthy competition and short-term thinking</td>
<td>• Preparatory studies are required to determine the market potential • Identify the financial incentives needed</td>
</tr>
<tr>
<td><strong>Resource mobilisation</strong></td>
<td>• sustained and long-term commitment and support (subsidy)</td>
<td>• sustained and long-term commitment and support</td>
<td>• Develop mechanisms for self-financing • Provide loans</td>
<td></td>
</tr>
<tr>
<td><strong>Creation of legitimacy (resistance to change)</strong></td>
<td>• Promotion campaigns</td>
<td></td>
<td>• Adapt technology to local needs and expectations</td>
<td>• Promotion campaigns adapted to the local context • Establish a sense of ownership</td>
</tr>
</tbody>
</table>
Conclusions from the case studies: drivers for technology diffusion

» Technology diffusion needs **time** and **dedicated innovation management** from all actors/stakeholders involved

» Both **simple** and **high-tech** technologies face similar challenges

» **Adaptation** of technologies to local circumstances, needs, expectations and culture

» **Legitimacy** and ownership

» Transparent and **sustained financial support**

» Government support and endorsement is essential for creating an **stimulating regulatory framework**, both in start-up and up-scaling

» Private sector involvement requires a regulatory **level playing field, viable market conditions** and a well-functioning **quality control** system

» **Focus on capacity building**, education, learning (by doing, interacting, using) of all stakeholders in the field of technology, management, business
# Actor roles in technology diffusion

<table>
<thead>
<tr>
<th>Innovation system functions</th>
<th>Public sector (host)</th>
<th>Public sector (donor)</th>
<th>Private sector</th>
<th>Civil society, intermediaries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrepreneurial experimentation</strong></td>
<td>• Deploy public funds to reduce risks for pioneering businesses and users: bridge valley of death • Establish a supportive environment for investment and for new start-up businesses • Solve IPR related issues</td>
<td>• Provide start-up funding for investments in new plants</td>
<td>• Invest in R&amp;D, training • Tap the potential of the informal sector</td>
<td>• Improve technical, financial, marketing and management skills of entrepreneurs and companies, including tacit knowledge</td>
</tr>
<tr>
<td><strong>Knowledge development (learning)</strong></td>
<td>• Initiate pilot projects, establish test facilities • Deploy public funds to stimulate R&amp;D</td>
<td>• Provide technical assistance • Engage in knowledge and capacity building • Strengthen the capacities of local authorities and institutions • Periodic monitoring of progress and results</td>
<td>• Develop/adapt new technologies, meeting the local needs, resources and circumstances • Include local knowledge and skills in R&amp;D • Continuous improvement and R&amp;D</td>
<td>• Document and include local knowledge and skills in R&amp;D • Build knowledge and human capacity by training local researchers and craftsmen • Encourage transparency among businesses and governments • Support continuous R&amp;D, aimed at the most adequate technologies and designs • Implement pilot projects</td>
</tr>
</tbody>
</table>
# Actor roles in technology diffusion

<table>
<thead>
<tr>
<th>Innovation system functions</th>
<th>Public sector (host)</th>
<th>Public sector (donor)</th>
<th>Private sector</th>
<th>Civil society, intermediaries</th>
</tr>
</thead>
</table>
| **Knowledge diffusion through networks** | • Identify and disseminate existing and new best practices  
• Support the set-up of sectorial organisations  
• Develop strategic partnerships between different sectors and policy departments in order to facilitate an integrated approach | • Share best practices  
• Support cooperation between government agencies across sectors  
• Set up and build the capacity of national programme coordinating institutions  
• Engage in partnerships with local organisations, particularly in regions with weak governmental structure | • Engage in pre-competitive partnerships  
• Demand innovation from suppliers and partners  
• Establish associations and sector organisations to regulate the sector | • Develop networks and partnerships to spread best practices  
• Education activities  
• Use local (established) networks for information diffusion  
• Create links between public and private stakeholders |
| **Guidance of the search** | • Develop a national agenda with tailored targets  
• Adopt and enforce environmental regulation  
• Define requirements for products, targets and quality standards  
• Control and enforce quality  
• Clean public procurement | • Provide and support policy guidance  
• Encourage adherence to international standards for performance and safety, facilitating export  
• Supply chain management  
• Enforce global environmental legislation to avoid burden shifting | • Develop product and service standards  
• Provide technical input to regulators  
• Demand innovation from suppliers and partners | • Identify and advocate policies that support the introduction of clean technologies  
• Monitor policy performance and provide feedback: ‘watchdog’  
• Work across organisations and countries to advocate for supportive policy, legislation and standards |
## Actor roles in technology diffusion

<table>
<thead>
<tr>
<th>Innovation system functions</th>
<th>Public sector (host)</th>
<th>Public sector (donor)</th>
<th>Private sector</th>
<th>Civil society, intermediaries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market formation</strong></td>
<td>Local and national governments, public institutions</td>
<td>Donor governments and multilateral institutions</td>
<td>Businesses, banks, investors</td>
<td>NGOs, academia</td>
</tr>
<tr>
<td>Technology brokering</td>
<td>• Technology brokering • Stimulate end-user demand, including affordability measures • Provide a stable policy environment for business • Maintain a viable market: avoid monopolies and disturbance of existing markets • Ensure quality and reliability by developing effective control mechanisms • Avoid charity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Support country governments in creating a supportive policy environment • Avoid charity, price dumping and disturbance of existing markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identify required changes in policies to spur investment • Perform preparatory studies to estimate market potential, proper design, institutional set-up and implementation modalities, in a participatory manner • Develop business and financial models to support clean technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource mobilisation</td>
<td>• Provide reliable electrification • Construct supporting infrastructure • Provide stable, long-term funding (avoid stop-and-go) • Strengthen local financial institutions • Adopt direct and indirect subsidy/tax/loan schemes in a transparent, sustainable way and evaluate effectiveness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Provide financial, but also human, technical and managerial resources • Direct financial investments • Provide stable, long-term funding (avoid stop-and-go) • Assessment of governance and capacity before providing funding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Develop mechanisms for self-financing, such as tradable side-products</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Mobilise philanthropic capital • Monitor government use of funds and commitments • Provide implementation capacity • Provide skilled coordinators and trainers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Actor roles in technology diffusion

<table>
<thead>
<tr>
<th>Innovation system functions</th>
<th>Public sector (host)</th>
<th>Public sector (donor)</th>
<th>Private sector</th>
<th>Civil society, intermediaries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Local and national governments, public institutions</td>
<td>Donor governments and multilateral institutions</td>
<td>Businesses, banks, investors</td>
<td>NGOs, academia</td>
</tr>
</tbody>
</table>
| Creation of legitimacy (resistance to change) | • Put environmental consciousness on the agenda  
• Raise public awareness on environmental issues by tailored education and promotion campaigns  
• Monitor and provide transparent reporting of results  
• Clean public procurement  
• Ensure law enforcement  
• Use media  
• Create ownership | • Impose rigorous consumer research, field testing and monitoring before embarking on large scale dissemination campaigns  
• Engage local stakeholders and NGOs | • Identify consumer preferences, needs and expectations  
• Include social aspects in technology projects  
• Use local products and local craftsmen  
• Create durable, high quality products  
• Provide consumer choice  
• Create ownership  
• Provide high quality information and servicing | • Educate end-users about benefits of new technologies and behavioural change  
• Clean public procurement  
• Monitor stakeholder actions and report on progress  
• Reach remote and poor communities, most in need of help  
• Advocate between end-users, businesses, service providers and financial institutions  
• Use local, established networks to disseminate knowledge  
• Include social aspects in technology projects |
General conclusions

» **... on environmental technologies:**
  » A technology which yield direct benefits to the user, is more easy to diffuse

» **... on innovation in developing countries:**
  » A country's capacity to absorb and benefit from new technology depends on the availability of more basic forms of infrastructure (energy!)
  » Innovation policy schemes have to be tailored to countries’ specific characteristics
  » The different functions should be fulfilled by a variety of actors to avoid conflict of interest and maintain momentum

» **... on evaluation of technology diffusion:**
  » The theory of technological transitions and innovation systems proved very valuable to analyse technology diffusion processes, as they allowed to include important soft factors into the analysis
  » Start from a broad framework to understand the diffusion of cleaner technologies, because environmental benefits are only one of influencing factors
Thank you for your attention

Saskia Manshoven

Flemish Institute for Technological Research (VITO NV)
Boeretang 200 B-2440 Mol
+32 14 33 56 89
saskia.manshoven@vito.be

Study commissioned by the European Commission, DG Environment (ENTR/29/PP/2010/FC)
In collaboration with project partners: IDEA Consult, VITO, DTI, REC, Ecorys-UK