The Importance of 'Ordinary' Science, Technology, and Innovation at the Science-Policy Interface in sub-Saharan Africa

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Abstract

Policy makers in sub-Saharan Africa must examine ordinary innovation to bridge their high-tech aspirations of the fourth industrial revolution with the needs of people needing a livelihood now.

Innovation, even in low–and middle-income countries (LMICs), is often understood in reference to 'frontier' technologies. Rwanda and Kenya are exemplars of African states vying for position as leaders in technological innovation on the regional if not global stage. None of this would happen without supportive government policies, especially around to attract skills and expertise and to incentivize research and development).

Promoting the high-tech sector in the sub-region shows bold leadership; policy makers are playing the long game. However, The World Bank reports that formal labour markets have not kept up with livelihood needs and it is the informal sector that is likely to continue to absorb most new job seekers for the foreseeable future[1]. Despite the region's fourth industrial revolution aspirations, it is the informal economy that will provide the necessary bridge to Africa's homegrown industrial future. For instance, according to the International Labour Organization, Rwanda must produce 200,000 off-farm jobs annually to keep up with labour market demand. Yet, frustrating labour market analysts and industrial sector policy makers, is a dearth of data in how the informal sector works and innovates[2]. This brings additional challenges and opportunities for nurturing the long-term economic stability, and sustainability.

There are two key gaps in policy that need to be addressed, then: 1) we must identify innovation where it occurs (we call this ordinary innovation), and, 2) we must cultivate the generative potential of local or indigenous knowledge in bringing about ordinary innovation.

The informal economy is the largest sector in sub-Saharan Africa. In Africa most workers derive at least some of their livelihoods from the informal sector that is intimately linked with local needs, opportunities, and productive pathways. It is ordinary innovations that secure social benefits, as they are cultivated from the need to solve everyday problems and meet livelihood requirements (see Table 1).

Table 1: Informal Sector in Sub-Saharan Africa

Region	Including Agriculture (%)			Excluding Agriculture (%)		
	Men	Women	Total	Men	Women	Total
Sub-Saharan Africa	86.4	92.1	89.2	71.6	82.8	76.8
Central Africa	87.1	95.2	91.0	73.2	88.2	78.8
Eastern Africa	89.1	94.0	91.6	72.3	82.1	76.6
Southern Africa	38.4	42.4	40.2	34.4	38.2	36.1
Western Africa	89.8	95.0	92.4	81.0	92.3	87.0

Source: (ILO, 2020)

Ordinary innovation can be described as an extension of an existing technological innovation into a product or service. For Eglash (2004) is the adaptation or refunctioning of existing technology and approaches to create solutions. In other words, there may be more than one problem to which a device or waste can apply[3]. This is what we call 'ordinary innovation'; where one

[1] Adams, A *et al.*(2013) *Improving Skills for the Informal Sector*, Washington, DC: The World Bank.

[2] Mustapha, N *et al.* (2022) Measurement of innovation in the informal sector in Africa: the importance of industrial policy, *Innovation and Development* (12): 325-342.

[3] Eglash, *et al.* (2004) *Appropriating Technology*, Minnesota: University of Minnesota Press.

redesigns an existing innovation to address a particular need.

Innovators draw from local conditions and knowledge bases to create new products from existing technology. Examples of ordinary innovation are legion and extend around the globe (see below). A formal education can be useful here but does not guarantee one's innovative capacity. In response to someone who argued West Africa had a dearth of engineers, a wise person countered, "we have plenty of engineers in West Africa, but they are not trained to do anything". Following industrialized countries, who typically rely on formal training in basic and applied sciences, many LMICs see this training as a precursor for innovative activities.[4]

Yet, at the same time, **Local/indigenous knowledge** refers to skills and practices that communities develop through interactions with their surroundings[5], lived experiences, way of life, cultural values, belief systems, and educational structure and curriculum. Combining indigenous knowledge with one's surroundings is key to sustainable start-ups, which can reduce poverty and inequality.[6] Scholars and practitioners "acknowledged the importance of local knowledge spillovers on the entrepreneurial process. A key reference in this domain is the knowledge spillover theory of entrepreneurship" [7].

Academic studies support this idea. In Namibia, for example, researchers examined the relationship between innovation and indigenous knowledge. They show that the "doing-using-interacting" mode of learning and indigenous knowledge create comparative advantages and provide the ability for positive societal change in the local communities.[8]

This relationship supports community resilience and poverty reduction[9]. Hence, one can argue that an integration of Indigenous knowledge systems in various sectors is essential for sustainable development.

The World Bank, the OECD, and others have called for performance indicators that focus on the informal economy and its innovations. We contend these aspirations must not slow simple changes to policy and initiatives that could help the sector move from just surviving to thriving.

'Ordinary Innovation' in Action: Case studies

This section analyses three cases of ordinary innovation. The first two cases examine truly indigenous forms of ordinary innovation. The last example shows that supporting informal economies and ordinary innovation coupled with basic training in applied silviculture, chemistry, and engineering can support livelihoods, resilience, and quality of life.

Plastics Reuse in Building Materials in Ghana

In the west African country of Ghana, 1 million tonnes of plastic are discarded each year. An additional 2 tonnes arrive as import each year. Of that, roughly 10% is recycled[10]. Plastic waste is burnt, eaten by animals, blown around, and rarely reused (see Photo 1).

Photo 1: Burning plastic waste

[4] Malerba, Franco, and Luigi Orsenigo. "Schumpeterian patterns of innovation." *Cambridge journal of Economics* 19.1 (1995): 47-65.

[5] Local and Indigenous Knowledge Systems (LINKS) (unesco.org)

[7] Ezeanya-Esiobu, Chika, and Chika Ezeanya-Esiobu. "Research, innovation, indigenous knowledge and policy action in Africa." *Indigenous knowledge and education in Africa* (2019): 97-10

[8] Hooli, Lauri Johannes, and Jussi Sakari Jauhiainen. "Building an innovation system and indigenous knowledge in Namibia." *African Journal of Science, Technology, Innovation and Development* 10.2 (2018): 183-196

[9] https://www.fao.org/3/y5610e/y5610e02.htm

[10] National Plastic Action Partnership. (2021). A roadmap for radical reduction of plastic pollution in Ghana.

Nelson Boateng of Nelplast LTD saw an opportunity from this plastic waste. He developed markets, technology, and products to support his environmental goals. He protects his workers from the toxic fumes associated with plastics and has transformed tens of thousands of tonnes of plastic into pavers and structural bricks (see Photo 2). Currently, with university partners, he is creating roof sheathing from a mixture of plastic and coconut fibres.

Developing an E-Waste Marketplace in Dakar

In Dakar, Senegal, Boussoura Talla Gueya and Julie Repetti formed SetTIC, a Senegalese women-owned business with the goal of developing a proprietary e-waste market where sellers would employ best practices to protect themselves and the environment from the deleterious effects of e-waste (see Photo 3).

Photo 3: SetTIC's Leaders

Through an innovative platform designed by SetTIC and university partners, the company created a web-based marketplace and app that was compatible with technology requirements in Senegal as well as translation into the local languages, French and Wolof.

Livelihoods: Meeting people where they are

Photo 4: Artisanal Mining in Ghana

Our final example comes from two polluting activities: e-waste processing and artisanal and small-scale gold mining (ASM). Both of these activities are under scrutiny in about everywhere they are active. Despite this scrutiny, e-waste processing and mining jobs are the only sources of income in some places. Ghana, for example, has sought to ban ASM country-wide (Photo 4) and wire burning at Agbogbloshie (Photo 5).

Ordinary innovation, if supported by policy makers through regulation and appropriate incentives, could overcome many of the issues related to these hazardous livelihoods.

Photo 2: Wire Burning at Agbogbloshie

Findings

These three case studies demonstrate the massive capacity indigenous people have for ordinary innovation. Whether it is burning wire or moulding blocks from waste plastic, the ingenuity of the people involved here is impressive.

- With minimal interventions, and appropriate incentives, SetTIC is striving to clean up the e-waste processing sector to create value that stays in Senegal and provides people an exit from poverty (see Figure 1).

Figure 1: SetTIC and e-waste

- Nelplast seeks to include other waste products in their building materials, such as coconut fiber as a substitute for sand. They also seek to make additional building materials, such as roof sheathing. The latter could be a game changer for housing affordability across the region.

Photo 5: Nelplast blocks and pavers

- Working with and gaining the trust of e-waste processors and miners led to two exciting innovations that protect human health and the environment while sustaining people's livelihood. Photo 6 displays a retort to safely capture mercury and its vapor during the gold beneficiation process.

Photo 5: A retort for safer mercury capture

- Figure 2 represents a "burn box" that can be used for burning PVC coating off of copper wire while protecting human health.

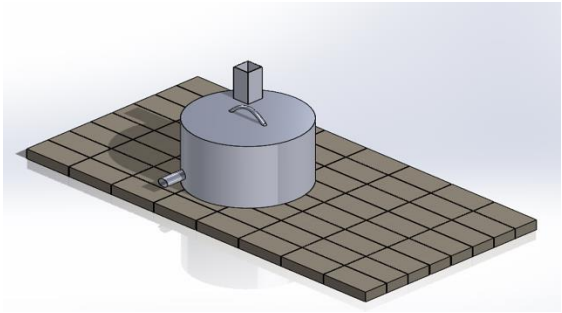

Figure 2: A "burn box" for PVC wire burning

Both of these interventions cost less that 50 USD to produce.

Policy recommendations

- To stimulate and sustain local and regional economies in sub-Saharan Africa, link policy measures to 'ordinary' innovation.
- Work in parallel to 1) create indices of the economic output and, 2) employ case studies to identify practices that can be supported through policy interventions, such as the mining and e-waste processing.
- Overcome limitations of STEM education that leave graduates out of the labor market, through project-based and practice-based learning.
- Create informal educational opportunities in collaboration with Technical and Vocational Education and Training (TVETs), universities, and maker spaces to support people who did not advance their education past junior secondary school.
- Promote ordinary innovation in more mundane sectors like basic industry and agriculture. Many commentators agree, policy makers must look beyond the fourth industrial revolution if they are to move the needle on employment, which is to create off-farm jobs for everyone—now.

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