Co-creation of Affordable and Clean Pumped Irrigation for Smallholders

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DARE-TU Project: Co-creation of Affordable and Clean Pumped Irrigation for Smallholders

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INTRODUCTION

Given the substantial amount of smallholder farms worldwide (Lowder et al., 2016), intensification of their crop production is crucial for increasing local and global food security (Tscharntke et al., 2012). Although irrigation water is not the only influencing factor in agriculture, improving (or enabling) its access and control is a major option to secure smallholder production as well as improving their livelihoods (Burney and Naylor, 2012). A way to achieve this goal is to provide intensified irrigation by using pumping technologies to water farmlands that will remain otherwise unirrigated. However, many current irrigation systems operate on electricity- or diesel-based pumping technologies. On one hand, this means high operation and maintenance costs due to the continuous use of electricity and expensive fossil fuels, respectively (Aliyu et al., 2018; Chandel et al., 2015), thereby becoming (too) cost-intensive for smallholder farming. On the other hand, these systems are strongly linked to air pollution due to their gaseous emissions and noise, hence affecting the local environmental quality as well.

A more environmentally sound and at times less expensive alternative for smallholders would be pumped irrigation systems that operate on renewable energies, i.e. solar power, wind power, biomass/biogas, hydropower (Gopal et al., 2013). From these, hydro-powered pumping (HPP) technologies, namely those hydro-mechanically driven by the water they lift, pose further advantages over their other RE-based counterparts. (i) Their energy source is, in general, locally available 24/7, relatively concentrated and more predictable; (ii) they have a higher power-to-size ratio, thus are more cost-effective; (iii) they are mechanically less complex and more robust, hence less maintenance-demanding and long-lasting; and, (iv) they are typically more efficient (up to 85 %) (Fraenkel, 1986). Despite these obvious advantages, most HPP technologies have not been used steadily over time, and are largely ignored nowadays. Moreover, their pitfalls lie beyond their mere technical performance: failures and misuse, thus eventual phasing out of HPP technologies, have found their roots in lack of proper management systems and business models (Intriago Zambrano et al., 2019).

RESEARCH APPROACH

In this context, the DARE-TU project aims to study a more robust, empowered, and sustained integration between the Integrated Turbine Pump (ITP) – an innovative HPP device that operates simultaneously as pump and turbine – and smallholder irrigation schemes, by means of an iteratively co-created Sustainable Product Service-System (SPSS). The latter, built by the bottom-

up inputs of stakeholders (e.g. smallholders, businesses/organizations), does not focus in merely selling potentially unaffordable pumps but in providing ITP-based irrigation services to the community. In this way, the SPSS is able to cope with financial restrictions, management issues and environmental concerns, while at the same time creating social value for the smallholders and profit for the businesses (Boukhris et al., 2017). Furthermore, this process is conducted under the light of the innovative Context Variation by Design (CVD) approach, through which proposed SPSS designs are intentionally and systematically exposed to different contexts in early stages, so richer and more-satisfying solutions can be achieved (Kersten et al., 2017). In particular, this paper will focus on the co-creation process of the ITP-based SPSS in two different smallholder irrigation schemes (i.e. contexts), located in Nepal and Indonesia, respectively.

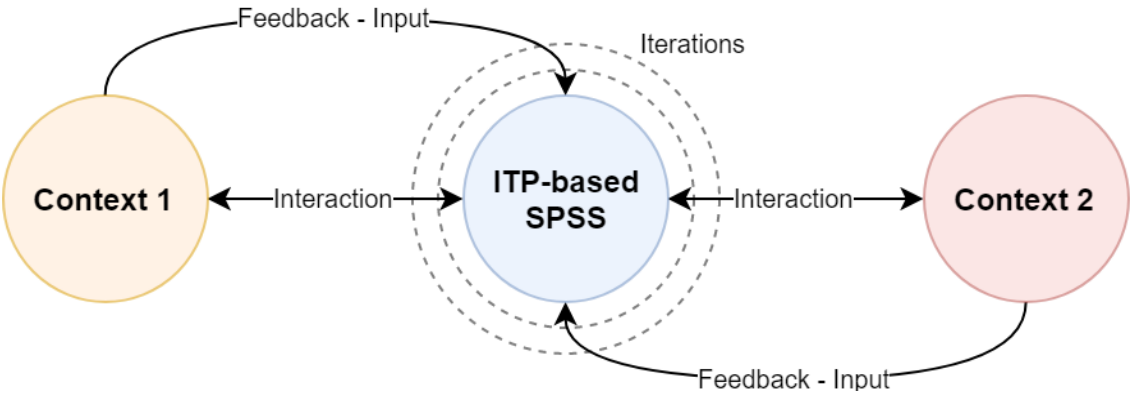

Figure 1. Co-creation of ITP-based SPSS. An early SPSS model, comprising both product (ITP, infrastructure) and service (irrigation water, others) is exposed to two different contexts; the reaction of (non)human agents (i.e. smallholders, other stakeholders, landscapes) in each of them, serves as feedback to co-create a second iteration of the SPSS that will be then re-exposed, thus repeating the cycle

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