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Challenges and opportunities for human-centered design in CGIAR

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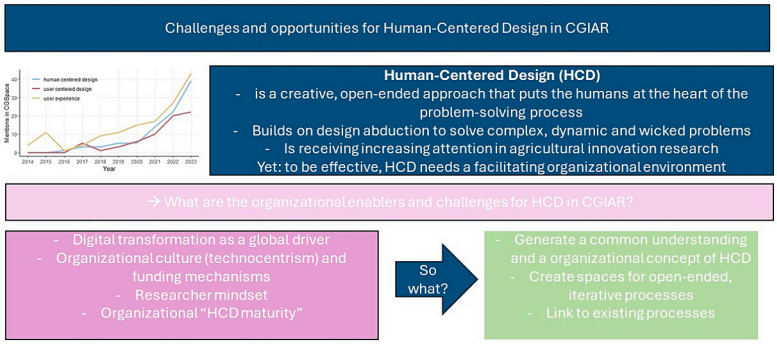
HIGHLIGHTS

- Innovations in AR4D often struggle with low adoption and low inclusivity, partly due to design-reality gap.
- Open-ended, creative, and human-centered design processes can help overcome technocentric and researcher biases.
- We discuss enablers and challenges affecting how design processes can close design-reality gaps in CGIAR innovation.
- We propose creating spaces for open-ended creativity, mindset change, and developing a human-centered design model.

GRAPHICAL ABSTRACT



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ABSTRACT

CONTEXT: Human-Centered Design (HCD) is an open-ended, iterative, and creative approach to problem solving. HCD is increasingly applied in CGIAR, a global AR4D consortium, to overcome problems with adoption, use, and inclusiveness of innovations. With the current digital transformation in food, land, and water systems HCD is gaining more traction. HCD is a process that can help create solutions that are adopted by users and are more inclusive. But the potential of HCD is strongly influenced by the organizational context that surrounds the design process.

OBJECTIVE: In this article, we want to increase the understanding of the organizational embeddedness of HCD as a process and contribute to the ongoing discussion around the role and operationalization of HCD in AR4D. We provide a reflection and discussion on the challenges and opportunities for HCD implementation in CGIAR and provide recommendations to increase systematic HCD integration into CGIAR innovation processes.

METHODS: We are building on the literature as well as the experience of the authors in facilitating HCD processes in CGIAR. We complement this by applying a simple maturity survey developed by Nielsen Norman Group, a global UX consulting firm. This maturity survey gives a more structured idea of the organizational situation in

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different areas with regards to HCD implementation and effectiveness. We identify a few action areas to improve HCD implementation in CGIAR.

RESULTS AND CONCLUSIONS: We identify three main areas that have a strong influence on HCD processes in CGIAR. A global driver for HCD is the digital transformation in food, land, and water systems: the sharp contrast between available tools and the low number of adoptions and lack of inclusivity drives the search for new ways of doing innovation research. At the organizational level of CGIAR, mindset and funding mechanisms have a strong influence on HCD implementation, presenting both challenges and opportunities. The organizational maturity, meaning how strategically HCD is integrated in organizational culture, strategy, processes, and outcomes, is relatively low in CGIAR.

SIGNIFICANCE: The importance of discussion on how AR4D should develop innovations that are adopted, are inclusive, and are scalable is reflected in the current reform in CGIAR. This article provides a perspective on HCD as a process-based, open-ended, and creative approach to problem solving that can help address this challenge. This can inform strategy and operationalization of HCD in CGIAR and AR4D in general.

1. Introduction

Agricultural research for development (AR4D) is often criticized for being too technology-centric (Conti et al., 2024; Adenle et al., 2019; Leeuwis et al., 2018). The design of innovations is frequently driven by technological possibilities and assumptions about impact pathways between the innovation and food system parameters. This conventional approach to problem solving, however, often falls short of producing innovations that solve complex, situated, networked, and dynamic problems (Dorst, 2015). These solutions fall short in addressing the wicked problems we must solve in the current and future food, land, and water system dynamics. Innovations that are generated mainly based on technical feasibility carry the risk of weak adoption, as they may disregard actual needs, socio-economic and cultural context, and target group behaviors. As a result, we see a strong design-reality gap in agricultural innovations (Masiero, 2016). Many innovations developed through AR4D face low or unsustainable adoption by the target group (McIntire and Dobermann, 2023). Moreover, many agricultural technologies are designed for a supposed 'average' user and fail to consider the diversity of needs of more marginalized groups, like women, indigenous people, elderly, and disabled people (Oudshoorn and Punch, 2008; Steinke et al., 2024; Waller et al., 2015). Technological determinism describes an understanding of technological innovations and development that happens disconnected from social, economic, and political context, pushed by a design paradigm building on technological logic (Wyatt, 2008). The other important assumption of this research paradigm is that social change follows technological change (Wyatt, 2008). Technology studies have challenged this worldview (prominent examples are (Latour and Woolgar, 1986; Marx and Smith, 1994) among many others). This research and innovation paradigm leaves little space and responsibility for considering human or other relational aspects (environment, politics, inclusion) in innovation design.

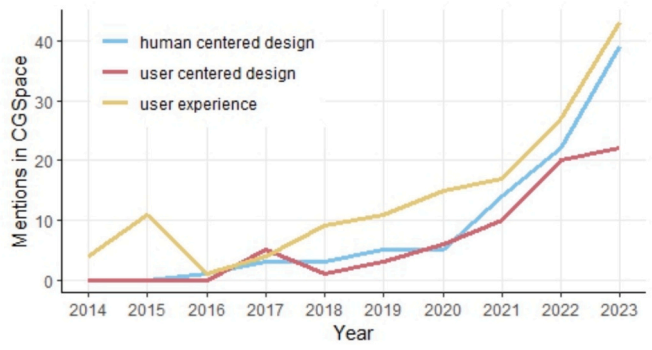

Fig. 1. Mentions in CGSpace for Human-Centered Design, User centered design and user experience. Own elaboration based on keyword search on https://cgspace.cgiar.org/home

The pitfall of a technologic-centric innovation design is becoming evident in the ongoing boom on digital agriculture in the Global South: a recent report shows that there is lower adoption of digital tools than expected, especially among women (Feed the Future, 2024). Challenges for an equitable digital transformation of food systems are often attributed to unequal digital skills and unequal access to digital infrastructure (GSMA, 2023; Lythreatis et al., 2022; Mehrabi et al., 2020). But observed disbalances also suggest that digital innovation research needs to pay more attention to the people who are supposed to interact with the solutions (Feed the Future, 2024; Ortiz-Crespo et al., 2021; Steinke et al., 2021). A common recommendation for enhancing the adoption and inclusiveness of digital innovations relates to a stronger engagement with users in the innovation process, allowing to better design solutions that consider their needs, their context and lived experiences (ibid.).

CGIAR is a global research partnership concerned with providing scientific innovations that help address global problems such as climate change, food insecurity and biodiversity degradation.[1] CGIAR positions itself at the forefront of the digital transformation of the food-land-water system in the Global South.[2] For this, CGIAR needs to overcome the challenge of persistent design-reality gaps and work towards (digital) innovations that are developed and designed through inclusive and human-centeredness co-design processes (Masiero, 2016; Meinke et al., 2023). This implies obtaining an in-depth understanding of the target group's needs, challenges, preferences, and habits, as well as intense involvement of the target group in ideating and testing ideas for solutions. Human-centered design can be here one promising pathway for designing fit-for-purpose and inclusive innovations tailored for the food-land-water systems in the Global South (Coggins et al., 2022; Holmes, 2020; Steinke et al., 2024).

In recent years, there has been increased interest among AR4D stakeholders in innovation methodologies that follow a Design Thinking tradition. Human-Centered Design (HCD) and related approaches, such as User-Centered or User-Experience Design, are finding their way into AR4D, with a particular strong uptake in relation to the digital agricultural transformation (McCampbell et al., 2022; Ortiz-Crespo et al., 2021; Parker and Sinclair, 2001; Sigauke, 2020; Steinke et al., 2022). Over the last years, there has been a sharp increase of CGIAR publications addressing HCD and related concepts (see Fig. 1).

HCD is a creative, iterative, and open-ended approach to problem solving: it intends to find solutions that improve people's lives, are inclusive for a diversity of users, context aware, fit-for-purpose and easy to use (IDEO.org, 2015). A human-centered design process includes different stages: exploration phase where the focus is on understanding the context, the problem and empathizing with the user; ideation where the insights challenge assumptions and inform first design ideas; and

[1] https://www.cgiar.org/

[2] https://www.cgiar.org/annual-report/performance-report-2020/cgiar-digital-strategy/

prototyping and testing where solutions are created and tested directly with the user. It is important to understand that this is not a linear process, but there are iterations between the different stages throughout the innovation design process.

HCD can potentially increase development costs upfront but is likely to generate cost savings and productivity increase in the long run: it is easier (and less costly) to correct design decision in an early prototyping stage than in an already deployed product (Marcus, 2005, InVision, 2019). Products will often need less user support after deployment. And innovations designed with a focus on inclusion can reach a broader user base and improve user satisfaction (Waller et al., 2015). Including a human-centered lens into the innovation process opens possibilities to reduce the likelihood of adoption failure and increase the chance of reaching the intended impact across the user base (e.g. with marginalized users, such as low-literates or tech novices).

2. The growth of HCD in agricultural research-for-development

Despite recently growing use of HCD in the A4RD sector, there is not yet systematic evidence on the value and impact of HCD on digital tool adoption or inclusiveness of digital innovations in the Global South. The application of the approach seems to be a good way of shifting the mindset towards a more empathetic, creative, and open-ended way of working (Mani-Kandt and Robinson, 2021). The team of authors of this article includes CGIAR innovation researchers who started engaging with HCD through their direct experience with the challenges of a technology-push approach that continues to be common in agricultural research, and digital agriculture in particular. The authors do apply and enable the use of HCD in digital agricultural innovations in CGIAR in areas as diverse as breeding, agricultural advisory, climate services, or food system monitoring. This includes e.g. supporting the human-centered design of image-based digital phenotyping tools for advanced breeding (Ortiz-Crespo, 2023), increasing the user-experience of an on-farm testing platform used in breeding teams (Londono, 2024), informing how digital data collection tools could be more gender inclusive in their design (Bonilla et al., 2023), and how climate information services can be better communicated to end-users (Zapata-Caldas et al., 2023). Beyond integrating HCD in digital design, the experience extends also to increasing the awareness of HCD in CGIAR to enabling colleagues and partners to apply HCD themselves, e.g. through Capacity Building (Ortiz-Crespo et al., 2023) or the customization of tools that help integrate HCD in innovation processes (Steinke and Schumann, 2022). Support is often coming through external HCD consultants who support CGIAR research teams in better integrating HCD principles into their innovation process. The consultants bring in the perspective from the private sector and start-up community.

Boxes 1 and 2 describe two case studies of how members of the team of authors approached capacity building and tool development for HCD within CGIAR. Box 3 describes a case study of how HCD has been integrated into an innovation process in crop breeding.

In our own experience, we often see the limitations and challenges for HCD to being effective in CGIAR innovation processes: innovation research is solution focused, not open-ended, it is difficult to integrate the iterative process in innovation projects and the collaboration in cross-functional team is often frustrating. This often limits the effect of HCD on the innovation design process. This phenomenon is not unique to our experience.

Research from streamlining Design Thinking in other sectors, mostly private, shows that the value and impact of HCD on innovations depends strongly on the organizational context. Whereas the research sector and mission-oriented focus of CGIAR are obviously different to these sectors, the approach to solving societal problems through technological breakthroughs seems to be quite similar (Conti et al., 2024). Research shows that organizational strategy, structures, culture, and routines are important factors that shape an organization's capacity to embrace and execute design effectively (Molich et al., 2020). This extends from the dominant organizational culture to budgeting and research management to attitude, leadership support and organizational goal setting (Sauro et al., 2017). The organizational setting affects how sophisticated and effective an organization approaches user experience and human-centered research, design, and implementation.

There are common organizational challenges to the adoption of design approaches in organizations, stretching from the organizational culture and mindset to budget limitations, missing support and trust from colleagues and leadership and not enough training and expertise (Bergart, 2020). Low design maturity means uncoordinated design efforts (and often related: unsuccessful products), limited financial and human resources, and a lack of leadership endorsement - factors that limit the potential of design approaches (Mani-Kandt and Robinson, 2021; McCampbell et al., 2021).

For a more systematic understanding of organizational patterns and to support strategies that increase organizational maturity, several authors and design practitioners developed so-called design maturity models (Drahun, 2015). These models provide a framework to understand how effectively an organization is integrating design approaches models (Molich et al., 2020; Sauro et al., 2017; Traynor, 2022). Main dimensions that affect maturity are culture, processes, leadership support, strategy, and resources. Maturity is seen as a process, and the models help to formally understand maturity, to benchmark organizational performance, and to develop strategies that increase maturity. On the critical side, these maturity models may oversimplify the complexities of design integration in diverse organizational settings. In different teams, projects or departments of an organization different maturity levels might co-exist.

Building on our experience and observations as HCD practitioners in CGIAR and inspired by the literature on organizational maturity for organizational design integration, we critically (self)reflect on the organizational enablers and challenges for HCD in AR4D and CGIAR context. We complement our own reflection with a short survey among CGIAR staff about HCD maturity.

3. What is HCD and how can it be useful in AR4D?

Despite the recent increase of terms like HCD, UX, and UCD in CGIAR (see Fig. 1) in recent years, we want to emphasize that the use of design approaches for creative, user-centered, and iterative innovation processes is not new and rooted in a long tradition of design research and practice (Holeman and Kane, 2020; Royal College of Art, Boyd Davis, S, and Gristwood, 2016).

HCD, UX, Design Thinking, and similar terms, have become buzzwords in mission-driven innovation research and, recently, in the digital agricultural sphere. Critical voices claim that this is merely a fashion trend that over promises quick fixes and oversimplifies how design experts actually work (Kimbell, 2011). The use of the different terms seems arbitrary and confusing for outsiders. Even for us that we now worked for several years with HCD, it is not always easy and straightforward to delineate the different terms and concepts. ISO provides a definition of Human-Centered Design:

"Human-centered design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance." (ISO, 2019).

This understanding of HCD is a good starting point. In our applied experience in AR4D, we see a conceptualization of HCD that integrates much more a participatory, multidisciplinary, and contextualized understanding of the human-centered design process. More in line what (Holeman and Kane, 2020) describe for the public health sector: a holistic view on the human as a person beyond a reductionist view on

touchpoints and product-related experiences. That is why we often refer to the conceptualization of HCD promoted by IDEO.org, an international non-profit design organization. IDEO.org describes HCD as a creative problem-solving approach that puts the needs, behaviors and living context of humans at the center of the innovation process (IDEO.org, 2015). We acknowledge that this understanding of HCD will also be shaped by our role in an impact-driven, non-profit research area that aims at improving the lives of people in the Global South. We see Design Thinking as the designerly "mindset" for HCD, user-centered design, UX or service design. Whereas the method toolkit for each of the approaches is the same, what changes is who we have in mind when we design the solution (a user, a person) or what we design (a product, a service or a complete user experience across different elements and touchpoints).

A common question asked by fellow AR4D research colleagues when they learn about HCD the first time is: so, what is new about this? Isn't this what we always have done, e.g. with participatory research, just nicely repackaged? We believe the answer is yes and no. HCD integrates elements of qualitative, ethnographic, participatory research that have indeed a long tradition in the CGIAR and AR4D (Ashby, 1997; Becker, 2000). HCD and participatory research approaches share many elements, whereas HCD adds a systematic process of designing and testing solutions, ideally in a multidisciplinary team (Chen et al., 2020; Katoppo and Sudradjat, 2015). Nevertheless, there are distinguishing elements that make HCD more than a repackaging of existing approaches.

HCD and the core concepts of Design Thinking distinguish themselves through a different way of reasoning compared to conventional research. Conventional problem-solving builds on deductive or inductive research (Dorst, 2015). In deductive research the different elements of a research problem and how they interact are known and can predict the outcomes (e.g. the combination of nutrients and soil characteristics can predict soil health as we know the underlying chemical mechanisms). Inductive research helps to discover patterns: we understand certain elements of a phenomenon and understand the outcomes, but we do not have knowledge of underlying patterns that influence the outcome (e.g. agricultural practices influencing yield is known, but unknown how norms, traditions, economic status influence agricultural practices). Here, researchers engage in observation and creative thinking to build hypotheses that in turn can be testable. Deduction and induction are not enough when we want to create new things like products or services. Here is where abduction comes into play: the creation of a new element for the problem space so that the interactions lead to an intended outcome (Dorst, 2015). But normal abduction falls short when we have complex, connected, situated and dynamic problems. In normal abduction, the problem space is not questioned, neither are the underlying patterns and relationships (Dorst, 2015). In our example it is the (simplified) assumption that offering information on soil health will change agricultural practices and lead to healthier soil and yield increase. Here comes the fundamental difference of designerly thinking that differentiates it to conventional research approaches to problem solving: design abduction. Here, there is some knowledge of the outcome to reach (e.g. resilient agricultural systems), but we have to create the elements and start understanding the relationships in parallel. To stay in our agronomic examples: in normal abduction we would like to improves the application of agricultural practices to increase soil health through training. Then we create the training (in-person, remote, etc.). In design abduction we would like to increase farm resilience to climate change but don't know how. This re-framing of the problem space opens the door for applying creative and experimental techniques to approach a solution and distinguishes design from other approaches of research and problem solving. In a nutshell: design abduction is a new way of looking at a problem situation and of acting within that situation (Dorst, 2015). This differentiates approaches like HCD from other research and problem-solving practices in CGIAR and AR4D in general.

4. Approach

We approached the question on the organizational challenges and enablers of HCD from two different angles.

This experience of the author's team gives us a unique perspective and understanding on how organizational context shapes the implementation of HCD. During a team retreat in summer 2023 several of the authors engaged in a systematic reflection that helped us to identify organizational patterns that we think matter for effective HCD implementation in CGIAR. We also ideated about how an "ideal" organizational context could look like, inspired by (Molich et al., 2020). In an iterative process, we clustered and grouped the items to identify four main areas that we consider relevant on an organizational level when scaling/streamlining HCD into an organizational context.

We acknowledge that a reflection based on our own experience might not be free of bias. We might tend to focus on aspects that confirm our experience or assumptions (confirmation bias), or we might tend to attribute challenges with HCD implementation to organizational and external factors rather than reflect on our own role within these challenges (self-serving bias). To get additional feedback on our perspective, we included the perspective of external HCD experts in our feedback, that do have experience working as an external consultant for CGIAR in one or various projects. We think that this helps to nuance our perspectives.

Additionally, to complement the researcher perspective with a broader view on organizational dimensions of HCD implementation and address possible biases, we developed a short survey adapting the Nielsen Norman Group (NN/g) UX maturity quiz to our focus on HCD (For details on the survey and the HCD maturity quiz see appendix 1–2).

Formally assessing an organization's UX maturity involves an analysis building on data coming from a combination of sources, e.g. structured surveys, expert interviews, stakeholder consultations, revision of organizational routines, and administrative processes related to UX. A formal maturity assessment goes beyond the scope of this paper. The idea to use the maturity model here is to add a more global perspective to the perspective of the team of authors. We opted for the NN/g maturity model: it is relatively popular and easy to apply, as the short survey is available online (Nielsen Norman Group, 2023a). The value of the insights for our perspective paper is that it guides the focus from individual HCD efforts towards stressing the importance of organizational change for effective HCD implementation.

The NN/g model focuses on four areas considered key for an organization that wants to become user-centered: strategy, culture, processes, and outcomes and describes six stages of maturity: absent, limited, emergent, structured, integrated and user-driven (Nielsen Norman Group, 2023a). Culture considers organizational and leadership support for human-centered design approaches; strategy focuses on goal setting and resource prioritization; processes look at research and design process planning; and Outcomes is about how design impacts products and how this is measured. We slightly adapted the wording of the questions to adjust it to our conceptualization of HCD and added a few additional questions to inform about the background of the respondents (see appendix 1 for the adapted maturity model and appendix 2 for the detailed survey instrument). We tested the quiz in the team to assure understanding and usability.

We sent the survey to an initial group of 90 researchers across different CGIAR centers. We only contacted researchers of the Digital

Innovation and Excellence in Agronomy Initiative.[3] The survey was approved by the Initiative leads, participation was voluntary and completely anonymous. Participants consented to having their responses used for analysis. We invited colleagues to share the survey. We received a total of 24 responses. From these, we considered 23 for the analysis. We eliminated one entry as it was evident from the comments that the respondent did answer the survey from a different perspective. The response rate lays within what we expected based on previous experience with conducting online surveys in our institutional setting. We cannot discard a self-selection bias here, with people being more aware of HCD more likely to respond to the survey.

How NN/g estimates the maturity level is not publicly available. We replicated the estimation of the level and validated the results using the NN/g maturity quiz online.[4] We estimated the maturity level as follows: for each question, we estimated the mode of each response value. Then we estimated the group mode across the different questions to reach the estimate of the organizational maturity level.

5. Enablers and Challenges for HCD in CGIAR

We discuss four main areas that we identified as important to conditioning the integration of designerly approaches in CGIAR research. First, a persistent, global trend towards the digital transformation of food-land-water systems, creating greater demand and receptiveness for established ideas from the tech sector across other (non-digital) parts of A4RD. Second, the organizational culture in CGIAR and funding mechanisms for AR4D projects in general shape how HCD integrated into existing innovation research processes. Third the mindset and routines of individual researchers that influence how HCD is perceived and accepted. And fourth, the overall organizational maturity to effectively integrate HCD. Each of these dimensions currently includes both drivers and hindering factors.

5.1. Global driver: the digital transformation in food-land-water systems

We see the global trend towards the digital transformation of the global food, land, and water system as a driver and enabler for HCD in CGIAR and AR4D in general. In recent years, digital innovation research within CGIAR has become increasingly prominent and well-funded (Kropff et al., 2021; King et al., 2021; CGIAR Initative on Digital Innovation, 2022). At the same time, however, the limited success of past digitalization initiatives has spurred recognition for the need to do better: it is acknowledged that, to achieve high rates of adoption, digital solutions must better address complex and diverse target context (Abate et al., 2023). There is also concern about the risk of reproducing or even increasing the exclusion of people already marginalized in "the real world" (Klerkx et al., 2021; Rose et al., 2023). In response, there have been calls to ensure that digital innovations are created with stronger awareness of local context user needs (Steinke et al., 2021; Coggins et al., 2022; Feed the Future, 2024). We find that the widespread acknowledgement of the limitations of past, technology-driven efforts in digital transformation has generally favored positive attitudes towards HCD within the A4RD ecosystem – also beyond digital development.

For example, the current OneCGIAR Research and Innovation strategy emphasizes the need to co-design inclusive digital products and services (CGIAR System Organization, 2021). The notion of "inclusive innovations" is increasingly becoming one of the cornerstones of the innovation process (Meinke et al., 2023). "Inclusive innovations", however, is a blurry term lacking a universally agreed definition. Within the strategic framework of CGIAR, the definition follows as proposed be (Heeks et al., 2013) that conceptualize inclusive innovations as a contextualized process to develop products and services …"for and by those who have been excluded"," This strategic shift in conceptualizing innovation as the result of an inclusive process favors the integration of design approaches. Digital transformation researchers have already been practicing HCD, for example, in the CGIAR Research Initiatives on Digital Innovation and on Excellence in Agronomy. HCD approaches are included into use cases in order to design new or improve existing digital solutions (Ortiz-Crespo, 2023; Steinke et al., 2023). Also, there is awareness raising and capacity building around design approaches (Ortiz-Crespo et al., 2023; Zapata-Caldas et al., 2023). In summary, although HCD as an approach is not limited to research on digital products and services, the need for digital transformation has widely raised attention on the potential usefulness of these approaches within A4RD.

5.2. Organizational drivers: Organizational culture and funding mechanisms

HCD is not a mere set of methods that can be plugged into any project context. As a holistic approach to problem solving, HCD needs an adequate institutional environment to unfold its potential. Established structures and workflows influence the implementation and effectiveness of HCD. The organizational culture in CGIAR and AR4D is dominated by a narrative where better technologies are the principal drivers of change towards more sustainable and equitable food, land, and water systems (Glover et al., 2019; Van Etten, 2022; Vanloqueren and Baret, 2009). This prevailing technological determinism in AR4D is a significant challenge for an approach like HCD that promotes an open-ended and technology-agnostic view on problems. The narrative of the transformational power of technological solutions is part of a technical research regime in AR4D (Leeuwis et al., 2021) and neglects the embeddedness of seemingly technological problems in a wider systemic context that needs to be considered (and addressed) in order to create innovative solutions that reach impact and transformation (Glover et al., 2019; Hall and Dijkman, 2019).

This focus on developing and disseminating predefined technology – rather than, for example, changes in values or behavior – shapes how research is framed, and how research processes are organized. In many A4RD research projects, the solutions are already presented at the proposal stage that outlines the research project or innovation process: the challenge is framed around developing a particular solution to address an identified or to increase the adoption of a given technology to reach intended impact. For example, typical A4RD projects address poor nutrition as a problem that can be addressed by breeding and introducing improved crop varieties – requiring little to no local ownership of the solution (Van Etten, 2022; van Ginkel and Cherfas, 2023). Or low agricultural productivity is explained by to the use of blanket fertilizer recommendations, focusing on improving site-specific soil-nutrition models, overlooking the connectedness to problems as low-resource endowment or missing availability of fertilizers (Müller and Schumann, 2023). While such 'linear', technology-centric projects can indeed lead to important positive impacts on local livelihoods and food systems (Mishra et al., 2022) this way of planning and implementing research also leaves little opportunities for identifying underlying problems and viable solutions together with affected population. It is also more difficult to integrate the opinions and knowledge of the target group into these predetermined innovation processes.

In other words, the use of HCD is currently hampered by the predominantly linear processes in funding and executing research, where both problems and solutions need to be specified in advance of the project. This is contrary to how innovations processes framed with a

[3] CGIAR has a portfolio of Research Initiatives that are funded through organizational core funding and bilateral grants. Research Initiatives cover a range of themes and regions and are all targeted to impact on five critical impact areas: Climate Adaptation & Mitigation; Environmental Health and Biodiversity; Gender Equality, Youth and Social Inclusion, Nutrition, Health & Food Security; Poverty Reduction, Livelihoods & Jobs. See https://www.cgiar.org/research/cgiar-portfolio/, accessed 12.9.2023

[4] (https://forms.nngroup.com/s3/Maturity-Quiz)

HCD lens, where the design challenge is framed with a human perspective instead of focusing on organizational goals (How can we solve a problem vs. how can we increase adoption of a solution). The challenge is broad enough to allow for discovery and exploration and does not focus on a particular solution too early. In our experience with design processes in AR4D over the last years, the direction of the eventual solution was often already predetermined, and the challenges were organization-focused. For example, the goal was to increase adoption of an existing product, or to develop and deliver a data dashboard (Steinke et al., 2022).

This narrow focus on specific technologies or outputs is, in part, due to the dominant way international donors assign funding for AR4D. Donor priorities and donor culture have a significant influence on research foci and processes in AR4D. The analysis of funding trends towards AR4D highlights the fact that technological solutions are preferred, overshadowing the embeddedness of innovations in a wider context of institutions, regulations, people, and culture (Pingali et al., 2016). To ensure funded projects align with donors' priorities, bidding research organizations are usually required to define solutions at the proposal stage, parting from assumptions and hypothesis about local needs and context. In our lived experience, this makes it difficult to request funding for open-ended and iterative processes that do not hypothesize a solution upfront. This is a known and expressed critique: donor orientation towards funding scalable technological fixes with measurable impacts makes it difficult to consider and integrate the human and contextual dimension of innovation use (Lynam et al., 2024; Schurmann, 2018). This tends to disadvantage disciplines with a more constructivist approach to reality, including qualitative, ethnographic, and contextualized research approaches that are often used in a design process.

Another factor that according to our reflection influences significantly how HCD can be implemented in CGIAR is the way in which research projects are managed and implemented. Typical A4RD projects undertake research activities sequentially, with pre-specified deliverables due at certain points in time. To fulfil predefined requirements, project milestones are sometimes prioritized over iterative design and potentially dissenting user feedback. Technical and user requirements for solutions are typically gathered upfront, and the project goes through defined stages (analysis, design, implementation) where each phase is completed before the next phase starts. This does not help in building multidisciplinary teams and it is not conducive to an iterative cycle, that is at the core of a design process. We have experienced that this linear approach, implemented in many CGIAR innovation projects, challenges the effective integration of HCD.

On the other hand, we also see enabling aspects for HCD in the current research culture in CGIAR: time for discovery and processing of insights is routinely planned for in innovation projects; using validation and testing techniques is also common; and participatory research has a long tradition in CGIAR (Ashby, 1997). These aspects can enable user interaction, exploration, and the focus on really understanding the problems and needs.

In line with the growing interest for contextualized and inclusive research among CGIAR senior management (CGIAR System Organization, 2021; Meinke et al., 2023), increasingly, research projects allow for more iterative and human-focused innovation processes and more openness to qualitative and contextual research. Also, CGIAR researchers are creating a growing number of examples and experiences where HCD has contributed to project success despite organizational challenges and limitations (see experiences outlined earlier). There is an increase in roles related to HCD, UX design or product design. These success stories help to integrate HCD more systematically and effectively in the AR4D innovation process. Design approaches can complement the current research and practices of scaling of innovations, and related systems thinking approaches (Pourdehnad, 2016). The focus on scaling has been increasingly integrated into the CGIAR innovation package and scaling readiness process (Schut et al., 2024; Schut et al., 2020), but does currently lack the focus on the incubation of ideas and human-centered development of products and services. This continues to open the way for a more effective integration of design approaches in AR4D innovation processes.

5.3. Individual drivers: Researchers' mindsets, routines, and networks

Another important aspect that we identified as influential for HCD implementation is the current mindset and values of CGIAR researchers. The research background of CGIAR science staff can enable the effective application of design approaches: scientists are typically familiar with questioning and validating hypothesis. Knowledge of statistics and data analytics as well as qualitative and participatory research methods is common, which aids in making relevant discoveries together with representative samples of the target group. Multi-disciplinary teams are common in CGIAR, making most researchers used to working with scientists from other disciplines. We experience many scientists as generally open to testing new ideas. In our experience, this interdisciplinary and innovative mindset has been helpful for introducing and adopting design approaches that build on exploratory and qualitative methods. In particular, social scientists tend to have expertise in qualitative and participatory research methods. This makes it easier for them to link with the exploratory and ethnographic elements of HCD, especially when it comes to understanding stakeholders' problem perception, local context, and target user needs and aspirations. On the other hand, although we see many interdisciplinary teams, the collaboration between disciplines in a research project is not always smooth and does not correspond to the way how teams should collaborate in an HCD process: often, individual scientists work in isolation to solve a particular problem from their perspective. The researcher explores user needs and context, hands this over to the developer, who will try to triangulate the research insights with the data analytics solution provided by the Data Scientist. We have also seen that, when applying HCD, researchers tend to overfocus the exploratory and ethnographic research part, at the cost of investing time in having faster iterations between the different cycles.

Although AR4D scientists are generally used to validating and testing, the focus is usually on testing advanced prototypes or already deployed products, such as the testing of already operating agricultural advisory platforms (Müller et al., 2023), rather than early-stage concepts. Testing ideas, not products, requires stronger flexibility from researchers, and the willingness to revise their questions spontaneously. This change in research practice can be a challenge towards becoming human-centered and inclusive in the innovation process, as it might be too costly at this stage to change features or even the direction of the solution.

Discussions and tensions around the right balance between quantitative and experimentally driven natural sciences and qualitative, context-oriented humanities, and social sciences in CGIAR have a long tradition (Becker, 2000; McIntire and Dobermann, 2023). We acknowledge that there have been significant changes over the last 10 years with regards to the role of social and ethnographic research (CGIAR System Organization, 2021). What nonetheless experience that the value of methods that build on qualitative, participatory, and ethnographic approaches is measured against quantitative benchmark (representative and large sample, statistical effects etc.) We see skepticism also with regards to the degree of user involvement in the innovation process. For some researchers the notion of "human-centered" leaves the impression that HCD means to be driven entirely by user desires and fear these overrule research results, researchers' expertise, knowledge, and technological possibilities. This links more to a misconception of HCD, as the process integrates and builds solutions around user needs, but explicitly considers aspects like feasibility and viability and offers ways to integrate researchers experience (Xue and Desmet, 2019).

The benefits and costs of different types of users or farmer involvement in agricultural research has been up for debate for a long time

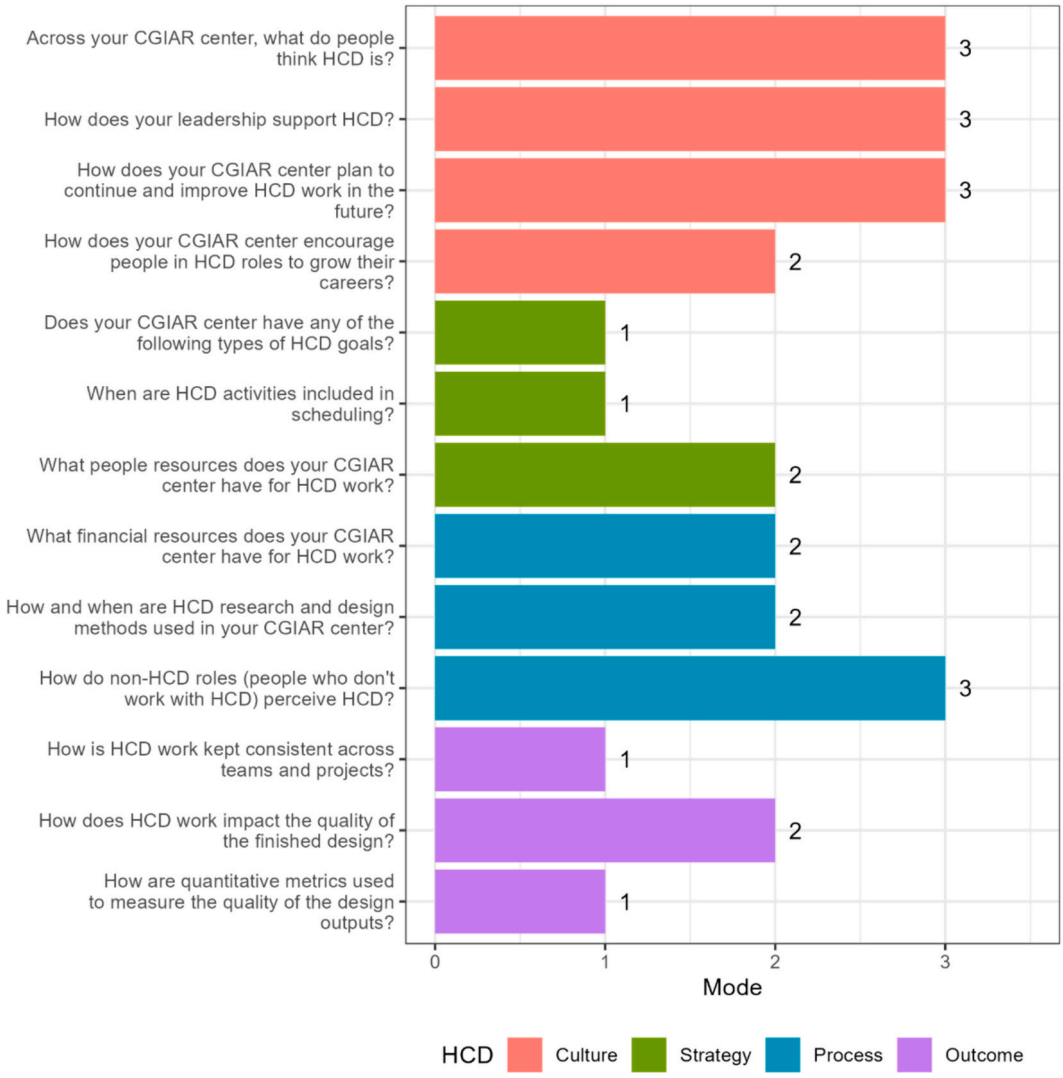

Fig. 2. Maturity score per question (mode), 23 respondents. 0 equals the lowest level of maturity, whereas 5 equals highest level of organizational maturity. For detailed questions for each category and number of responses see supplementary material.

(Neef and Neubert, 2011). With no one-fits-all blueprint, user involvement in HCD can also vary considerably, for example, by autonomously creating ideas and assembling prototypes, or providing iterative feedback to the design team (Steinke et al., 2022).

A very practical problem towards effective HCD integration is the constant pressure for CGIAR scientists to change research processes and focus to generate impact at scale, also linked to the ongoing reforms in CGIAR (Leeuwis et al., 2018; Meinke et al., 2023). A certain 'change fatigue' can influence how new approaches and innovation processes are accepted and implemented (De Vries and De Vries, 2023).

Another enabling factor that we identified as important that relates to the mindset is the supportive peer network of creative and engaged colleagues on which researchers can rely on. People in CGIAR are used to working in an international environment and tend to have an intercultural mindset and sensitivity and empathy for cultural differences. This likely helps researchers embrace the HCD mindset that focuses on building empathy with the target group and understanding their hopes, aspirations, needs, and challenges.

Encouragingly, we recently note a shift in mindset among research leadership towards recognizing the value HCD for the ongoing digital transformation within the organization and the digital ecosystem focus on the partner countries. Increasing support from people in leadership positions at the executive level, research initiative leads, and from direct supervisors of researchers is a significant enabler for HCD in the CGIAR, as this strengthens the strategic embedding of the approach and shapes how operational budget for HCD is allocated and fosters solutions that go beyond thinking about how the newest technology can solve a problem.

5.4. Additional determinant of change: Organizational maturity in CGIAR

To complement the reflection and analysis on drivers and challenges for HCD in CGIAR from our author perspective and supported by the literature, we include here a brief insight into the organizational maturity of CGIAR. We used the N/N g maturity quiz as outlined in the method section.

The overall maturity level is 2, on a scale from 1 to 6. At this stage, design efforts in organizations are described as uneven, haphazard, and aspirational (Nielsen Norman Group, 2023b). Organizations at stage 2 tend to mention users in their vision but prioritize shareholder or in CGIAR case donor requests over user needs, with sporadic funding and awareness for human-centered processes. There's a vague understanding of HCD, yet misconceptions persist. Basic methods are used with design inconsistencies due to a lack of shared tools. HCD work, though present, lacks quality due to limited resources, and metrics are often

misused. This organizational perspective matches with our reflection and analysis in the previous sections on drivers and challenges.

The mode score of the response values for each question across the four sections gives a more detailed picture (see Fig. 2). The higher the score, the higher the maturity for each of the sections. Questions related to culture, like perception, and organizational support, scored highest with 3. As we have discussed in the previous section, there is increasing awareness of the value of an HCD approach and researchers in CGIAR are starting to embrace a human-centered mindset. The questions related to strategy and outcome scored lowest in our survey: currently, there are no HCD-specific organizational goals and HCD activities are not included in the scheduling as they should be. HCD work is not kept consistent across teams and projects and no metrics are used so far to measure the quality of the design outputs. For a detailed picture of the responses for each of the sections please refer to the data in the supplements to this paper.

HCD is increasingly recognized and valued across the organization, but there is no strategical embeddedness of the approach, nor are there yet strong consistent impacts. Resources are still spread very thinly; efforts depend on one or a few people. Processes and methods are not consistent, and metrics are almost not used. The increasing awareness but lack of strategy, processes and outcomes is typical for organizations at this maturity level (Nielsen Norman Group, 2023b).

Most of the respondents identified as CGIAR research staff. We reached colleagues from 7 different centers and the CGIAR System Organization. 19 out of the 23 respondents indicated that they had consciously used elements of HCD in their work. Some of the survey respondents left additional comments about what they considered relevant with regards to HCD. Respondents state that they have been familiar with participatory research approaches, and this led to inadvertently incorporating elements of HCD in their work.

6. Discussion and conclusions

In this perspective paper we show that external drivers and a general trend towards a more needs-based, problem-focused, and human-centered mindset push the interest in HCD in CGIAR. An innovative, curious, and exploratory internal culture and existing research processes are fertile ground for the approach.

Current attitudes and capacities of out-of-box-thinking are a good precondition for more effective HCD, but these attitudes need to be nurtured more strongly to successfully implement HCD at higher maturity levels. There are certain misconceptions about design and its role in innovation processes, and prejudices exist that lead to either overselling or belittling the value of HCD. No systematic HCD research and design processes exist within CGIAR, which makes it often difficult to realize the intended impact of HCD. Particularly the missing space to approach the innovation process in an open-ended fashion from the beginning is posing a strong challenge on the value and effectiveness of designerly thinking in CGIAR.

By applying a maturity quiz developed by (Nielsen Norman Group, 2023a) we get additional confirmation about the currently low level of design maturity in CGIAR. The current stage 2 maturity means that the use of HCD is still very limited in the organization. There is a general openness, and researchers do include some elements of HCD in their innovation projects, but still HCD is not systematically integrated into processes and does not deliver strategic outcomes.

This confirms what we see as HCD experts in CGIAR and AR4D: researchers are open and interested and see the need, but it is still challenging to effectively implement design processes in current organizational settings. It is important to note that there is not such a thing as one maturity level in the CGIAR. Although the individual responses in the survey did not show a strong variation, the maturity does differ between CGIAR centers, teams, or projects.

In the following we discuss key findings in more detail.

One red line throughout our analysis the technocentric and linear research paradigm that follows a conventional approach to problem-solving and innovation research. The narrative that pushes the research agenda of CGIAR is still building strongly on the need to generate technological breakthroughs to transform the current food, land, and water system (Rose et al., 2023; Van Etten, 2022). We also showed, however, that a shift in the mindset is beginning and and the need for new approaches to problem solving is becoming more prominent in CGIAR. But the tension between technology-centered innovation research and human-centered design processes will not disappear: there are opposing views on which focus is the "right" way forward to address the challenges in the global food, land, and water system (Conti et al., 2024). In the end, the question on how HCD is integrated into CGIAR is also related to the question about which organizational approach to research, innovation, and problem solving CGIAR will embrace in the future.

For us as HCD practitioners, this means trying to understand why there is a need for a simplified model of technological development and societal change in our complex and connected modern world (Wyatt, 2008). For CGIAR, this could mean for researchers from different disciplines to create a space where a critical reflection on technological development and societal change can take place. This could include reflections on our current research paradigm and how it shapes our interpretation of research results and technological possibilities. Exaggerated expectations around the potential of HCD should be avoided. The use of process-oriented and human-centered approaches will not revolutionize how we develop innovations and will not automatically result in technologies with higher adoption rates and more inclusive features (Weaver, 2020).

Our research emphasizes the role of organizational context in determining how effective HCD can be applied for human-centered and inclusive innovations. We see the need to further push the boundaries of our understanding of what works and not and in which contexts: By understanding how organizational context, research paradigms, and narratives shape the production of technology for societal change, we can move a step forward in building truly inclusive and democratic innovation systems.

HCD can be one important cornerstone for this process towards a more balanced view on innovation processes (von Hippel, 2005). Design thinking facilitates out of the box thinking, a new framing of the problem that opens up creative and unconventional ways of problem solving that corresponds to the complexities we face in our world (Dorst, 2015; Kleinsmann and Valkenburg, 2017). HCD processes help to integrate stakeholders and different disciplines to better work towards a common goal (Bonilla et al., 2023).

6.1. Recommendations

We still need more knowledge and experience to understand how we can better unlock the potential of HCD and designerly ways of problem solving in the particular context of AR4D and CGIAR. Organizational context in a mission-oriented research organization is different to the product and innovation context in other sectors where HCD is applied. It is a design challenge in itself to understand how HCD can be integrated into the complex organizational structure of CGIAR. Besides the challenges we describe, we experience an increasing demand and interest from researchers in CGIAR for HCD, this goes from support for capacity building and training, direct process support to asking to provide tools adapted to the AR4D context.

Following the framework developed by (Nielsen Norman Group, 2023a), there are some clear recommendations for organizations with a low maturity. It is important to focus on mindset and culture that embraces HCD. A big limiting factor at this stage is the lack of a clear understanding of concepts and methods across the organization. Efforts should go into creating a common understanding of concepts, methods, and the value of HCD. This could be done through seminars, but also through offering thematic check-in with experts and practitioners. It also

Box 1
Adapting and promoting HCD tools in CGIAR context

Experienced HCD practitioners are rare within CGIAR. Limited hands-on experience and skills may lead to HCD processes that deliver insights late, yield unsatisfactory outcomes, or even fail entirely. Self-motivated researchers can resort to vast online resources, including HCD guidebooks, templates, and design tools. But many of these materials were developed for corporate contexts in industrialized countries, with limited applicability in AR4D implemented in the Global South. Interviews with AR4D researchers in CGIAR revealed they would find it helpful to have low-threshold resources and tools that fit in with typical CGIAR context. Recently, multiple methodological guides and tools inspired by HCD have been released by and for CGIAR researchers, often targeting digital innovation processes. Examples include an action-oriented, broad introduction to gender-inclusive design (Müller et al., 2022) and a step-by-step method for enhancing the inclusivity of digital solutions, which relies on common HCD methods such as user journey mapping (Steinke and Schumann, 2022). Moreover, two comprehensive online toolboxes released by the CGIAR Initiative on Digital Innovation aim at enabling CGIAR researchers to select and apply methods for responsible digital innovation (https://co-lab.cgiar.org/responsible-digital-innovation) and user research (https://uxtools4ag.org).

Box 2
HCD awareness and capacity building

To design a hybrid learning experience for enabling CGIAR researchers to increase HCD capacity, we used a fourfold approach building on HCD principles: Interviews to understand the thematic focus needed by our audience - CGIAR researchers- as well as to collect experiences held so far with in-person and online training. Focus groups were held to discuss interest and fears around applying HCD processes. We also conducted an analysis of prior training needs assessments and interviews with other training providers (Scaling and gender inclusion) to discuss common learnings and experiences with training formats. The results were two-fold: We designed User Personas to understand different interests regarding learning habits, digital skills and needs for learning environments. These inform the design different learning journeys for HCD. This research informed the design and testing of different capacity building formats. We designed a 2-day introductory training for HCD, that was very well received by participants. It helped to create awareness for the process, but the follow-up and implementation in projects based on this short intervention is not clear. We currently design and test different online courses that provide different levels of introduction to HCD for AR4D professionals. We piloted an online HCD coaching for use case teams working on AR4D solutions. Participants really liked the coaching format, but it became evident that first HCD capacity is difficult to create in traditional AR4D teams and second, that it is challenging to integrate HCD into ongoing non-designerly processes.

seems relevant to include the leadership of the organization and centers in this process.

It is also important to focus on improving human-centered research and design processes. First efforts can go into harmonizing HCD tools and concepts across teams and projects.

For now, results of the different steps of the process (insight generation, prototyping, testing results) are not generating any organizational learning process. A good way to create this organizational design knowledge would be to create a user knowledge repository, that systematically makes available user knowledge and testing results: e.g. insights on which message delivery channels work where, recommendations for inclusive web design, or protocols for effective user testing. This would help to lower the cost of integrating design into CGIAR processes and would increase the general knowledge in AR4D.

Developing a design cycle for CGIAR, that corresponds to the processes in AR4D is also a good way to work on harmonizing concepts. Understanding how HCD relates to other processes that are guiding innovation development in the organization, e.g. the Innovation Profile and Scaling Readiness Framework, can help to facilitate HCD acceptance and integration (Schut et al., 2024). HCD can support or complement these processes: scaling starts at a stage where products and services are already developed, but often struggles with innovations that fail to address the problem in the right way. HCD helps to integrate a perspective on desirability, viability, and feasibility of a solution. At the

Box 3
Digital phenotyping for advanced breeding: integrating a human-centered perspective.

HCD is integrated into Artemis, a project that develops solutions to help breeding teams with the time-consuming task of phenotyping of the different breeds (Ortiz-Crespo, 2023). The initial proposal started by stating a solution to an already formulated problem: develop a digital phenotyping tool to decrease the burden of manual phenotyping during the breeding process. This included the development of a computer vision model to extract traits from the pictures and a digital interface to collect them. Although this focus limited the exploration of the problem space and the ideation of unconventional solutions, HCD still had a strong impact on design decisions. Context analysis has helped to validate and expand the initial assumptions of the project, which has helped to identify research gaps and entry points for the proposed digital tool. Ideation workshops helped the team to translate the insights from the field into ideas. This also increased the buy-in from scientists and project leads on the approach itself. Rapid prototyping and testing generated a better understanding of the key features needed for the solution, and to correct mistakes before too much time and effort has been put into coding and back-end development.

User testing made clear that taking pictures manually of all the plants in the field was while maintaining consistency quite difficult and time consuming. This led to the development of a simple cart that helps sustain the phone and can be pushed through the plant rows in the plot. The cart can be built easily on-station. It also became clear that there are other challenges with regards to phenotyping that go beyond the burden of hand labor, as for example logistical problems (e.g. setting simultaneous fields in several locations) that have to be resolved in parallel.

same time, it is important to make sure that the iterative and sometimes messy design process is not too much dominated by the existing linear frameworks.

Finally, in our experience, demonstrating the value of HCD by carrying out successful HCD projects can have a strong effect on colleagues and partners in generating interest. HCD teams should invest time in applying human-centered research and design methods correctly and aim for integrating new methods into their HCD portfolio. The approaches and mindsets underlying HCD can be introduced little by little: we would like to see more spaces where researchers can approach a problem in an open-ended way, understand and frame a problem as proposed by design abduction before starting to build a solution to the problem iteratively for and with the people in mind that are supposed to use the tool. When we open up to new ways of thinking about the complex problems faced in our food, land, and water systems, we might see new ideas emerging that help solving problems in an unconventional way. How this can play out and how HCD can impact on the outcomes aimed for by CGIAR is a question that should be addressed in parallel with this process.

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Appendix A. Levels of HCD Maturity adapted from N/N g

CRediT authorship contribution statement

Anna Müller: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Jonathan Steinke:** Conceptualization, Investigation, Methodology, Writing – review & editing. **Hugo Dorado:** Data curation, Formal analysis. **Salome Keller:** Conceptualization, Validation, Writing – review & editing. **Daniel Jiménez:** Data curation, Formal analysis, Writing – review & editing. **Berta Ortiz-Crespo:** Conceptualization, Methodology, Validation, Writing – review & editing. **Charlotte Schumann:** Conceptualization, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data shared in supplements

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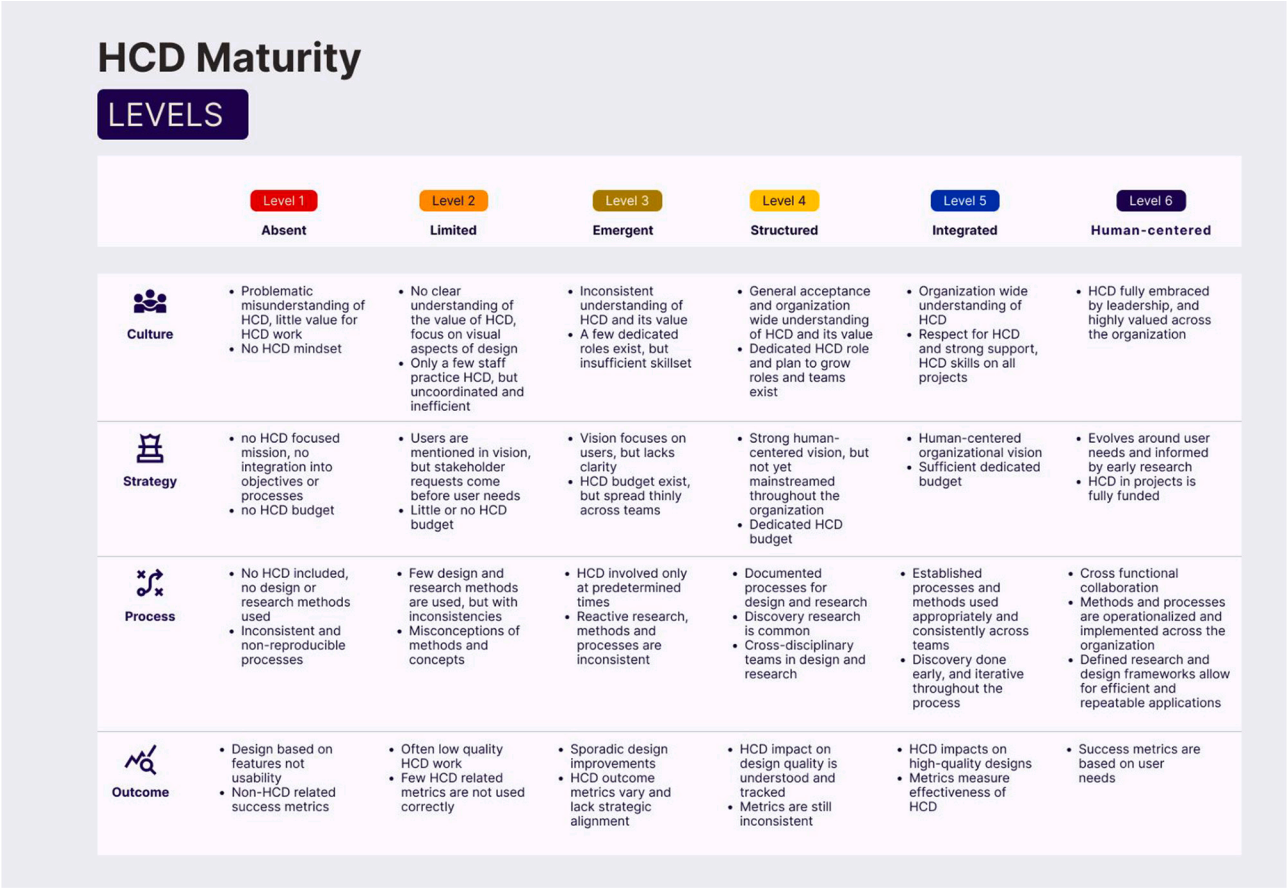

Appendix B. Survey

B.1. HCD maturity quiz for CGIAR

Thank you for contributing to the CGIAR-wide human-centered design maturity assessment!

The…what?

Human-centered design, or HCD, is a paradigm for solving problems by focusing on human needs and experiences. The concept is similar to user-centered design, user experience, or Design Thinking.

Through this survey, we measure to what extent CGIAR is already practicing HCD.

The survey results will help to strategize the path to stronger human-centeredness within CGIAR!

The survey includes 13 questions. It should take you no more than 15 min to tick your responses. It's based on the UX Maturity model by Nielsen Norman group.

All 13 questions are mandatory. If you are not sure what to answer, select the answer(s) you feel most comfortable with.

Thank you!

https://www.nngroup.com/articles/ux-maturity-model/

HCD CULTURE.

1. Across your CGIAR center, what do people think HCD is?

☐ People don't know what HCD is, or they have a problematic misunderstanding of HCD.

☐ There is an awareness of the concept of HCD, but limited understanding of the benefits it can provide (for example, it may be confused with visual design).

☐ Some individuals have a clear understanding of HCD, but many others do not.

☐ A consistent definition of HCD is understood across the entire organization, but is seen as being limited to interface design only.

☐ The definition of HCD is not only consistent across the organization, but is also understood as applying beyond interfaces, to systems and processes.

2. How does your leadership support HCD?

☐ Leadership does not support HCD in any way.

☐ Leaders are aware of HCD but are indifferent to it, or may even be hostile.

☐ Leadership mostly accepts the need for HCD, but there may still be some skeptical leaders who aren't convinced or don't provide enough support.

☐ There is HCD support at the highest level of the organization's leadership (for example, from the Director General or the Initiative leader).
3. How does your CGIAR center plan to continue and improve HCD work in the future?
☐ No HCD work is being done.
☐ HCD work is being done haphazardly. There is little or no effort to evaluate or improve the work.
☐ Some teams are working towards improving their HCD work, but not all teams are.
☐ Plans are in place to repeat and improve HCD work across the organization, on all teams.
4. How does your CGIAR center encourage people in HCD roles to grow their careers?
☐ No formal HCD roles exist.
☐ Few or no HCD roles exist, but some employees are self-motivated and add HCD work on top of their regular jobs.
☐ HCD roles may exist, but there are few HCD professionals in the organization.
☐ HR-related elements (job profiles, career paths) exist for HCD, but career growth is not widely tracked.
☐ Job profiles and career paths for HCD roles are well-defined and tracked throughout the organization.
☐ Job profiles and career paths exist for typical HCD roles (designer, researcher) but also for meta-roles like DesignOps and ResearchOps.
HCD STRATEGY.
5. Does your CGIAR center have any of the following types of HCD goals?
HCD goals are high-level objectives related to increasing the human-centeredness of innovation processes. Select all that apply.
☐ No HCD goals
☐ General HCD-related goals describing what HCD should be or accomplish
☐ Specific, well-defined and documented HCD goals
☐ Both short-term and long-term HCD goals
☐ Prioritized HCD goals, to indicate which are most important
☐ A roadmap or plan for how to achieve our HCD goals
6. When are HCD activities included in scheduling?
HCD activities may include, for example, user research, design workshops, ideation, or prototype testing. Select all that apply.
☐ HCD is not included in project schedules
☐ HCD work usually occurs before a research output is implemented.
☐ HCD work is usually included when planning project schedules.
☐ HCD is involved in task prioritization and work planning.
☐ HCD work is always part of early project planning, at least to scope whether it's needed
7. What people resources does your CGIAR center have for HCD work?
☐ No staff with specialized HCD skills or experience
☐ Some people with HCD skills or experience, but it is not their main job
☐ Dedicated HCD practitioners (or several people officially assigned to work on HCD as a major job function) but not enough to do all the needed work. Or external HCD consultants hired occasionally
☐ Enough specialized people and skills to address all current HCD needs
8. What financial resources does your CGIAR center have for HCD work?
☐ No money is spent on internal HCD staff, external HCD consultants, or other HCD resources.
☐ Some HCD work is funded, but there is no dedicated HCD budget.
☐ There is some HCD budget, but it's inadequate.
☐ There is an adequate, nearly-adequate, or even substantial HCD budget.
HCD PROCESS.
9. How and when are HCD research and design methods used in your CGIAR center?
These methods may include user testing, interviews, design workshops, prototype testing, etc. Select all that apply.
☐ No design or research methods are used.
☐ At least a few methods are used.
☐ HCD methods are used throughout the research and development process, not just at the end of the process.
☐ Established and documented HCD processes exist across teams.
☐ A wide variety of HCD methods are being used across projects.
☐ HCD methods are used even outside traditional arenas (for example, HCD methods are applied to strategy, service support, etc.)
10. How do non-HCD roles (people who don't work with HCD) perceive HCD?
☐ No HCD work is done, no HCD roles exist, and/or nobody talks about HCD.
☐ Among non-HCD roles, HCD is noted but not accepted or supported.
☐ Some individuals in non-HCD roles are curious about HCD activities and want to be involved, but most do not support HCD.
☐ Most non-HCD roles accept and support HCD, but the amount of support varies throughout the organization.
☐ Non-HCD roles have strong respect for HCD and work alongside HCD roles on HCD activities.
11. How is HCD work kept consistent across teams and projects?
In other words, is the HCD process consistent throughout the organization?
☐ It isn't: The only common thread related to HCD is not knowing or caring about HCD.
☐ Inconsistently: There are many inconsistencies across designs within and across projects.
☐ Consistently: Design process is similar or the same across teams and between projects.
☐ Systematically: There are established, successful frameworks across the organization, which are shared, maintained, and improved.
HCD OUTCOMES.
12. How does HCD work impact the quality of the finished design?
☐ Not at all: There is no HCD work being done, so there is no impact.
☐ Weak: HCD does NOT have a strong or positive impact on the quality of research outputs (due to lack of experience, politics, and/or education).
☐ Moderate: Teams are trying to produce high-quality work and many of them are successful.

☐ Strong: Many or all of the research outputs are of high quality and impact.
☐ Very strong: Outputs are good, they lead in research community and practitioner standards.
13. How are quantitative metrics used to measure the quality of the design outputs?
Popular HCD metrics include user satisfaction ratings, task completion rates, innovation uptake, etc. Select all that apply.
☐ No measurable indicators of HCD success are defined.
☐ At least a few HCD metrics are collected and discussed.
☐ HCD metrics are collected regularly and tracked over time.
☐ HCD metrics are shared throughout the organization.
☐ HCD metrics are shared with decision makers.
☐ HCD metrics influence decisions.
Lastly, please tell us about you.
We are interested in the variation within CGIAR regarding HCD maturity. These data will not be used to identify any individual respondents.
14. You are…
☐ Research staff
☐ Non-research staff
15. Which CGIAR center are you primarily affiliated with?
(List of Centers, including CGIAR Systems Transformation Unit)
16. Where is the office you are affiliated with?
☐ Central Asia
☐ East and Southeast Asia
☐ Europe
☐ Latin America and the Caribbean
☐ MENA region
☐ South Asia
☐ Sub-Saharan Africa
☐ USA/Canada
17. How many years have you been working within the CGIAR system?
18. Your activities mostly belong to …
☐ CGIAR Initiatives
☐ Bilateral projects
☐ Other
19. Until now, have you ever consciously used HCD methodologies in your work?
☐ Yes
☐ No
20. Any thoughts you'd like to share?

Appendix C. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.agsy.2024.104005.

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