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MASTER THESIS

**Postdevelopment Policy Information:
A GIS Design Workflow for the Pluriverse.**

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Supervisor: Dr Jiří Pánek

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Palacký University Olomouc

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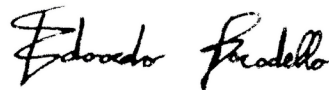
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Declaration

I, hereby, declare that this Master Thesis, entitled *Postdevelopment Policy Information: A GIS Design Workflow for the Pluriverse.*, is my original work for the GLODEP Erasmus Mundus Joint Master Degree in International Development Studies. I confirm that the work contained herein is my own, except where explicitly stated otherwise in the text through references or acknowledgements.

Date: 31st May 2021

Signature:

Handwritten signature of Eduardo Fredele in black ink.

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Zásady pro vypracování

Postdevelopment visualisation entails a process of acknowledgement of the 'enduring diversity of socialites; (Klein & Morreo, 2019, p. 8) which compose the imaginary and reality of 'development':. In fact, informing policy-making beyond the paradigms of linearity, exogeneity and convergence of contemporary development policy, necessitates the visualisation of already existing alternatives. Geographic Information Systems (GIS) platforms offer, indeed, a valuable instrument for the plural representation of data trends through a spatial perspective. The necessary and critical process of complexity reduction faced by policy-makers (Umbach, Guidi & Russo, 2018) can benefit from GIS-supported data visualisations which closely relate to the transformative advocacy of postdevelopment scholarship. Drawing from the McMahon, Smith & Whiteduck's (2017a, 2017b) workflow approach, the present research investigates the structuring of an accessible GIS design workflow to support a non-professional user in data-driven policy advocacy for postdevelopment with the software QGIS. Namely, the framework involves the organisation of 5 support sections for the process of creation of a visualisation: principles, methodology, data management, visualisation and interpretation. The research inquires into the 5 essential sections at the crossroad of recent scholarships in postdevelopment, critical GIS and evidence-based policy-making. Specifically, this analytical effort embodies the perspective of quantitative storytelling (Saltelli and Giampietro, 2017) and GIS as a socially build set of practices (Pavlovskaya, 2006; Schuurman, 2009), thus, incorporating uncertainty and conditional interpretation as natural components of evidence-based approaches.

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Putting geographies of hope and care on the map is a counter-mapping practice that sets limits to conservative geographies. At the same time, once on the map, the new worlds of which geographies of hope can be part do indeed feel possible.

(Pavlovskaya, 2018, p. 52)

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Abstract

The global encounter between critical and participatory GIS and postdevelopment is generating post-dualist and post-positivist approaches to GIS-based policy information. This study investigates the accessibility and agency of a FLOSS-based participatory GIS design workflow for a non-expert and low-resource user, within a paradigm of postdevelopment in practice. It articulates 14 GIS practices through 3 FLOSS technological resources (Ubuntu OS, LibreOffice and QGIS). The workflow is derived from a 10-week internship at the Alliance for Food Sovereignty in Africa (AFSA) involving the participation in daily activities and the creation of a web map of AFSA's case studies on agroecology. The research reports the complexity, the unintended agency and the collaborative potential for problem resolution within a FLOSS and open data environment. Besides, the collective discussion and piloting of the web map creation highlights the proactive engagement of postdevelopment 'intuitions' within GIS practice, while adjusting to a contextual critique of the 'development' discourse. Hence, the results support the relevance of negotiation and of sharing experiences within and outside of a workflow creation to inform GIS practices through contextual evidence and relationality. Such a process of knowledge emergence is found consistent with a deconstruction of the divide between the researcher and the research community for the generation of pluriversal policy information.

Keywords: Postdevelopment; Pluriverse; GIS design, Participatory GIS, Free/Libre Open Source Software (FLOSS); Policy Information.

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List of abbreviations

AFSA	Alliance for Food Sovereignty in Africa
AWM	AFSA's Web Map of case studies
CSO	Civil Society Organisation
FLOSS	Free/Libre Open Source Software
GIS	Geographic Information System
ICPAC	IGAD Climate Prediction and Applications Centre
NGO	Non-Governmental Organisation
ODbL	Open Data Commons' Open Database Licence
OSM	OpenStreetMap
OSMF	OpenStreetMap Foundation
PGIS	Participatory GIS

Alliance for Food Sovereignty in Africa

ABOUT AFSA

Launched in 2011, AFSA is a broad alliance of civil society actors who are part of the struggle for food sovereignty and agroecology in Africa. These include African food producer networks, African CSO networks, indigenous people's organizations, faith based organizations, women and youth groups, consumer movements, and international organizations that support the stance of AFSA.

It is a network of networks, currently with 40 active members in more than 50 African countries.

[...]

AFSA'S VISION

Africa developed in harmony with nature, harnessing its traditional knowledge and systems, and her people controlling natural and other resources and related decisions.

AFSA'S MISSION

The core purpose of AFSA is to influence policies and to promote African solutions for food sovereignty. AFSA will serve as a continental platform for consolidation of issues pertaining to food sovereignty and together marshal a single and louder voice on issues and tabling clear workable solutions.

(AFSA, 2020)



ALLIANCE FOR FOOD SOVEREIGNTY IN AFRICA

Introduction

Not feeling comfortable or sure about something, but rather in critical listening, is in the genetics of postdevelopment practice. Instead of fixed and generalisable solutions, the encounter of postdevelopment and GIS generates a post-positivist process of discussion, choice and self-analysis within an individual's context and across the involved communities. This leads, in turn, to disidentify with the ontologies of separation fuelling oppression and harmful 'development' discourses (Escobar, 2020), expressed within GIS practice by the paradoxical divide between: researcher & researched, qualitative & quantitative data or visualisation & interpretation. Indeed, the dismantling of some of the assumptions behind these dualist categories supports the design of post-extractive forms of knowledge.

This study crafts a FLOSS-based¹ participatory GIS design workflow aiming at both an high accessibility to non-expert and/or low-resource users and its consistency within a paradigm of postdevelopment in practice. The research project is supported by a case study involving the creation of a web map which was carried out in parallel to an internship at the Alliance for Food Sovereignty in Africa (AFSA), an NGO based in Kampala (Uganda) promoting policy information for agroecology and food sovereignty on the continent. Besides, after structuring the set of GIS practices and technological resources composing the workflow, their use as a practice of postdevelopment is investigated in terms of 'intuitions', methodology, data management and visualisations involved.

The research addresses the urgent need for a critical reflection over the growing popularity and accessibility of GIS and open data creation in Africa and internationally. Specifically, it is motivated by the low engagement of the postdevelopment literature within the context of critical and participatory GIS and the symmetrical poor use of the postdevelopment paradigm and practices made by contemporary GIS literature. Furthermore, the rationale of such an approach lies in exploring the dispute of the researcher's role as a *super partes* actor of a mapping process and in discussing what a de-professionalisation of GIS would entail. All such

1 FLOSS refers to 'Free/Libre and Open Source Software'. For further details on this concept see *Section 4 of Chapter 1*.

questioning is grounded in the needs of AFSA for a spatial organisation of its case studies on agroecology and, thus, it is exemplified through the participatory creation of a web map.

Hence, the research question was iteratively redefined and negotiated within the context of operations and it is summarized as it follows:

To which extent can a FLOSS-based participatory GIS design workflow embody postdevelopment in practice?

Moreover, a set of theoretical and practical objectives² were defined and negotiated to bound the answer to such a question according to: workflow accessibility, study positionality, operative strategy, literature streams, an African perspective and post-dualist methods. Such objectives characterise the study in a perspective of participatory action research within the perimeter of the experiences shared and of the limited collective use of GIS technology.

On a methodological ground, the study was embedded in a 10-week internship at AFSA where three participatory actions were defined: (1) building a web map of case studies on agroecology, (2) providing support with GIS visualisations, and (3) taking part in the NGO daily activities. While the technological inputs were mainly managed by the researcher, the shared experience provided contextual intuitions and collective discussions informing choices and visualisations, which were reported in a workflow diary of participatory observation and action revision.

On the one hand, given the limited previous experience of the AFSA officers involved with GIS and Free/Libre Open Source Software (FLOSS), an essential set of technological resources was defined by the researcher as follows: Ubuntu operating system (Linux), LibreOffice suite, QGIS. Concerning the data in use for the web map of case studies, the geospatial information is derived from the OpenStreetMap (OSM) database and the case studies' metadata from the AFSA' site internal records.

On the other hand, the participatory structuring of the workflow in 14 GIS practices is collectively informed via negotiation, discussion, piloting and evaluation. Specifically, it addresses: objectives, geographical definitions, target audience, languages in use, data integration strategy, visualisation and interpretation of the output.

According to the question and methods identified, the thesis is structured in four chapters followed by the conclusion. Firstly, the recent anglophone literature concerning critical and

2 The complete list of objectives is presented within the methodology in *Section 2 of Chapter II*.

participatory GIS and postdevelopment is analysed via a 'layering' process of their common and antagonist practices. The proactive engagement of shared intuitions and explorations as well as the hidden fractures and unintended agency of GIS are collected across the two distinct literature streams to formulate a common discourse.

Secondly, the context, methodology and data are exposed in the form of a collaborative and post-positivist strategy. This latter involved the contextual analysis of AFSA within a paradigm of postdevelopment, the definition of the FLOSS tools in use and the data environment for the web map.

Thirdly, the workflow is structured both in its technical and its conceptual organisation. After a brief presentation of the concrete process performed to obtain the final outcome, a set of 14 practices constituting the process are presented along with the examples of the negotiations and choices performed.

Lastly, the discussion of the workflow draws over the participatory experience to derive a set of 'requirements' for its use as a practice of postdevelopment. Such a 'de-professionalised' practice is articulated in: contextual negotiation over intuitions, a relational and reflexive methodology, a conscious use of software, cross-actors interactions around the management of data and the proactive engagement of postdevelopment interpretation through shared experiences.

In sum, the study offers an organised reflection over the use of FLOSS-based participatory GIS within postdevelopment. It highlights its complexity, its unintended agency and its collaborative potential for problem resolution. Furthermore, it demonstrates a proactive engagement of postdevelopment intuitions through contextual evidence, relationality and knowledge emergence. It also articulates the role of collective discussion and piloting as well as of a broader set of shared experiences, clarifying the relevance of negotiation within the process and the inconsistency of a strict divide between the researcher and the researched community.

I. Layering confluences across the literature of postdevelopment and critical and participatory GIS

Imagine watching over a crowded street from a balcony in a busy market of Kampala (Uganda). Flows of people, merchandise, emotions and ideas are simultaneously intertwining across the market, across the street as well as within the mind of each single individual. Even having access to free technology and data, the GIS mapping of such phenomena would at least entails a negotiation between all such flows, the selected means, and the original intention of the mapper. It is indeed based on such intuition that a GIS design workflow is studied under a postdevelopment perspective.

This review of literature addresses the construction of a FLOSS-based participatory GIS workflow for postdevelopment policy information. It does so focusing on the compatibility and risks embedded in critical and participatory GIS practice with special regard to promoting situated knowledge towards a paradigm of pluriversality.

The main research question is motivated by the interest in communicating the postdevelopment framework to policy makers. Namely, it focuses on applied experience in designing critical and participatory GIS practices for policy information, while the actual communication and use of the resulting policy information is beyond the scope of this research. Specifically, the question is articulated as follows:

To which extent can a FLOSS-based participatory GIS design workflow embody postdevelopment in practice?

Despite its specific nature, the question opens a variety of themes for which the following text is nothing more than a concise exploration. Besides, critical and participatory GIS literature has only recently opened more holistically to a practice that goes beyond the discourse of 'development'. Therefore, it is not yet established as a stream of literature connected to the postdevelopment critique.

The aforementioned question is addressed through a layering -much as in GIS software- of the literature of critical and participatory GIS with the one of postdevelopment in practice. The scope of this review is predominantly bounded to the anglophone literature of the last two decades. In the case of postdevelopment it draws from a spatially heterogeneous group of authors, while in the case of critical and participatory GIS from a widely European and North American grouping.

The following chapter starts with the section *0. Defining an unsettled conceptual panorama* to familiarise the reader with the concepts in use. It is then organised in five further sections which recall five major themes for the creation of a GIS workflow: (1) ontological & epistemological design, (2) process & participation, (3) subject & inputs, (4) means, and (5) interpretation & engagement.

Firstly, the GIS design is analysed under the lens of its ontology and epistemology to discern over its employment for the promotion of a plurality of knowledge systems. Secondly, the participatory dimension of GIS practice is investigated according to its negotiating capacity and the limits of its employment. Thirdly, the subject of mapping is examined in relation to the complex array of inputs which are necessary to a GIS workflow. Fourthly, the anti-hegemonic nature of FLOSS instruments for GIS is studied in association with the complexity and unintended agency that they carry along. Finally, the benefits of a de-professionalised GIS practice are related to the proactive engagement of postdevelopment in practice within policy information.

In sum, this review outlines the space of collaboration between FLOSS-based participatory GIS and postdevelopment in practice. A cautious set of limitations and unaware outcomes is delineated while identifying the constructive synergies between the two streams of literature.

0. Defining an unsettled conceptual panorama

The literature review makes use of three cardinal concepts: postdevelopment, pluriverse, and critical & participatory GIS design. In order for the reader to contextualise their meaning within this text, they are defined in the following sections.

Postdevelopment

This study takes its origins in the conceptual space of the postdevelopment critique of development studies. In particular, it addresses the recent stream of literature focused on visualizing and communicating *postdevelopment in practice*, as recently titled by Klein & Morreo in their edited book (2019).

The term 'postdevelopment', or 'post-development', generally refers to a conceptual paradigm portraying 'development' as a "complex discursive invention" (Escobar, 2018, p. xiii), i.e. the product of the imperialist rhetoric which supported colonialism and which intertwines today with neocolonialism and neoliberal discourses (Bassegy, 2019).

The historical nature of such debate is rooted in an oppositional genesis to the status quo of 'development' (e.g. extractivism, economic growth, linearity and planning), while assuming different semantic expressions and frames according to the context (Matthews, 2010). Nevertheless, recent literature has been increasingly reporting the proactive nature of the postdevelopment debate in connecting the *living alternatives* to 'development' of many communities around the world (Gibson-Graham, 2006; GWGBD, 2019; Kothari et al., 2014, 2019; Lang, König, et al., 2019). Namely, according to Klein and Morreo (2019, p. 8):

Postdevelopment in practice begins with the insistence that an enduring diversity of socialities, a multiplicity of southern knowledges and nature/culture assemblages and postcolonial political economies reveals already existing alternatives.

Pluriverse

It is indeed the idea of reclaiming not only the conceptual space of 'development' but also its counter-practices which opens an ontological debate over the plurality of social representations and ideas of progress (Shanin, 1997). As a result, the sociological imaginary of postdevelopment established in the international debate a companion concept, the one of the pluriverse (Escobar, 2018; Kothari et al., 2019).

The latter's definition could be essentially enclosed in the fact that the representation of achievable futures and of competing narratives over the present can converge in the Zapatista expression of "a world in which many worlds fit" (EZLN, 1996, p. 10). In this sense, the pluriverse is a conceptual space hosting multiple ontologies of life which challenges extractivism,

industrial consumerism, exploitative relationships, and the expectation of 'convergence' which was put in place by a Western patriarchal modernity (Klein & Morreo, 2019).

Critical & participatory GIS design

Participatory design has long played a relevant role in the context of reclaiming GIS practice towards the collective as well as in the broader tradition of critical geography and countermapping. In concrete, a Participatory GIS (PGIS³) design workflow is an operative set of practices, involving GIS applications and geospatial data, which pursue a balanced and negotiated interaction between a researcher and a community (Crampton, 2010).

As other forms of participatory research, it has been informed "by plural and overlapping principles from Marxist, anarchist and feminist thought and Indigenous epistemologies" (Wynne-Jones et al., 2015, p. 218). Furthermore, the recent experience in reclaiming its practice applies to all stages of design and use through the lived reality of user groups (McMahon et al., 2017). Critical and participatory GIS not only involves the rethinking of the methods of mapping and of creating geographical information but it also conceptualises a form of knowing that belongs to a qualitative to quantitative continuum (Pavlovskaya, 2006). It contests the production of top-down *super partes* opinions by invoking the co-production of geographical information, their use and the skills that support their creation and interpretation (McMahon et al., 2017).

1. Postdevelopment & critical GIS design:

A situated understanding of the world(s)

Postdevelopment in practice relies on the idea that dreaming up alternatives to 'development' carries the risk of obscuring the actual existence of a myriad of already living alternatives and systems of knowledge (Klein & Morreo, 2019). These latter have increasingly been addressed as a subject of critical GIS that is embedded in socially constructed practices.

3 The abbreviation PGIS is here used in reference to all participatory practices employed in GIS. A differentiated approach would picture -not without ambiguity- Participatory GIS (PGIS) as primarily related to on-the-ground activities, mainly led by NGO, in low-resource contexts, while Public Participation GIS (PPGIS) as mainly employed in public planning and citizen participation contexts, being led by academics and government agencies (Brown, 2017). Yet, for the purpose of this thesis and the paradigm employed, the selected abbreviation is intended to avoid such classification in order to address forms of participation beyond the dualist categories of 'developed' and 'developing' countries.

Recent critical GIS scholarship has reflected on the ontological power of maps in producing alternative world visions and geographies of the possible (Crampton, 2010; Pavlovskaya, 2018). Besides, the increased accessibility and -to a certain extent contradictory- democratisation of GIS have popularised the awareness around the fact that maps enable power relations and their dispute (Schuurman, 2009). Such processes have increased the attention over the accessibility and transparency of GIS software and geospatial data as shared social phenomena.

For instance, according to McMahon et al. (2017, p. 430), the process of reclaiming GIS design for indigenous and community user groups establishes GIS as a "socially constructed set of practices and technological resources". Thus, it can be socially re-designed to recall forms and ontologies of knowledge alternative to a mainstream (Labaeye, 2017). Making a parallel, it is also within the design process of the 'development' discourse that lies its reproduction. In fact, drawing from Ferguson's *reproduction thesis* (1990), Lie (2007, p. 54) highlights not only how "development's mindset and world-view are continuously reproduced by development agents and agencies" but also how this entails "reducing the relevance of other knowledge formations".

Hence, reclaiming GIS design for postdevelopment aims at reproducing plurality in the systems of knowledge employed in policy information. This, in turn, acknowledges that GIS practices encapsulate a *situated understanding* of the world according to each user group (St. Martin & Wing, 2007). Hence, such a conception of design is consistent with the postdevelopment literature in defining the actors of a process as "historically and epistemically situated persons (never autonomous individuals)" (Escobar, 2018, p. xvi).

In sum, raising concern with critical GIS design is assuming ontological and epistemological positions towards knowledge creation which increasingly converge with postdevelopment claims. Therefore, GIS practice may allow to play a new role in the promotion of plural systems of knowledge when integrating such perspective.

2. Output vs process:

Is Participatory GIS compatible with postdevelopment?

The growth of Participatory GIS (PGIS) practice and open collaborative technologies have been recently accompanied by a renewed attention to the processual nature of knowledge creation while revealing the embedded risks of the practice (Wynne-Jones et al., 2015).

PGIS practices offer a fertile ground for rejecting universalism in favour of *pluriversity* through their focus on processes. They meet a growing trend in postdevelopment advocacy in which action is formalised around a process rather than a project or organisation, e.g. the collective of the *Global Tapestry of Alternatives* (GTA, 2021) leading postdevelopment knowledge dissemination in such a fashion.

On the one hand, the conversational element of PGIS allows communities for constant ethical renegotiations across ontologies (Fraley, 2011), meeting the conceptual framework of *postdevelopment in practice* provided by Klein and Morreo (2019). Moreover, the social practice of GIS for knowledge creation (Labaeye, 2017) addresses the relational and community-building dimensions of research envisaged by the literature in both PGIS (McMahon et al., 2017; Wainwright & Bryan, 2009) and postdevelopment (Escobar, 2018; Esteva et al., 2013).

On the other hand, the same PGIS authors seem to suggest that the availability and complexity of GIS platforms and geospatial data (McMahon et al., 2017) as well as the *differential empowerment* they generate across the spectrum of involved agents (Wainwright & Bryan, 2009) pose substantial limits to participatory methods in a postdevelopment perspective.

Besides, drawing from the claim of Illich (1968), the *good intentions* leading practitioners and researchers risk to leave unfolded the GIS's vastly embedded use of Cartesian geography and its reliance on scientism and an often elite form of knowledge (Crampton, 2010). Consequently, PGIS practice's unintended outcomes potentially mine what Pavlovskaya (2009) defines a *post-positivist sensibility* of GIS, which in parallel to the postdevelopment literature fails to protect a "non-centralized and radically dispersed" knowledge process (Alvares, 2010, p. 253).

All things considered, PGIS presents a wide potential compatibility with process explorations and ontological renegotiations around the paradigm of postdevelopment. Nonetheless, it is structurally prone to producing unintended outcomes which could in turn enforce the dispossession of knowledge systems by elites and involved actors.

3. Critical GIS mapping:

A subject-input tangled nexus

In participatory mapping, the definition of the subject and the relations between this latter and the geographical inputs loom a complex panorama of negotiations. While on the ground of

intentions, critical GIS is exploring the ontological and epistemological prerogatives of postdevelopment, its coherent practice is strewn with obstacles.

On the one hand, postdevelopment praxis suggests that the subject of knowledge is formed *everyday everywhere* (Dhar & Chakrabati, 2019) informed by a “politics of co-production of subject and place” (Gibson-Graham, 2016, p. 288). The nature of postdevelopment knowing is deeply relational (Escobar, 2018) since the subject of knowing, as much as the needs which are driving it, arises from collaborative interactions (Illich, 1975, 2010). In critical GIS, the elements of such a recursive and decentralised process can find one of its expressions in the theoretical distinction between mapping, *counter-mapping*, *counter-counter-mapping*, and so on (Wood et al., 2010).

Besides critically engaging with the source of knowing, a common postdevelopment theme concerns breaking established dichotomies, such as the *developed-developing* semantics (Bassegy, 2019; Dhar & Chakrabati, 2019; Esteva, 2010). Such a trend is echoed by the growing concern of participatory geography for dismantling or escaping the ‘expert researcher’ *versus* ‘researched community’ divide (Wynne-Jones et al., 2015) or the ‘academic’ *versus* ‘activist’ practice’s impenetrable dogma (Russell, 2015). In fact, the opening of PGIS to negotiating, co-creating, and co-evaluating its subjects (Garrett & Brickell, 2015; Kesby, 2000) is building a narration of politics and participation which leaves the ‘development’ discourse to become a constantly reproduced concept (Escobar, 2020; Simpson, 2017).

On the other hand, the relations between the map subject and the geographical codified data used as inputs pose relevant questions over the unintended results that they may generate (McMahon et al., 2017). For instance, nationalities and foreign languages used as performing artificial boundaries (Bassegy, 2019) are constantly employed in GIS, producing a *semantic levelling* of knowledge which easily results in an underestimation of situated knowledge (Loften & Vaughan-Lee, 2019). Namely, while a careful approach to geolinguistic calls for ‘expert’ interdisciplinary support (Luebbering, 2013), decolonial geolinguistics’ praxis highlights an entangled complexity of the translation *per se* (Yates & Núñez Núñez, 2020), often beyond the user’s conscious choice.

Finally, the relations between the subject and the geospatial information (often free online data) open a Pandora’s box of considerations around their entangled performativity. A first example, concerning indigenous land reclaim, is provided by Wainwright and Bryan (2009) in their discussion over the potential capture of alternative approaches to ownership and usage rights in favour of the extension of property rights to affected communities. A second example is

reported in the workflow for visualising the gendered distribution of Vienna's street names created by the *genderATlas* project (Ledermann, 2018). In this latter case, the employment of algorithms to classify the gender of the street-name (from OSM data) initially amplified discrimination by hiding the extent of unequal distribution due to the historical custom of using the entire name only for streets entitled to women, which resulted in a better identification of the same.

In sum, postdevelopment's relational nature of knowledge and its opposition to dichotomous thinking are increasingly entering the space of participatory geographies. Nevertheless, despite the negotiating and collaborative practice of GIS raises awareness about the ontological needs that could guide mapping, the semantic and structural features enclosed in the geographical inputs risk to subvert the empowering intention which originally informed a workflow.

4. A walkable technological path:

The case for FLOSS application to GIS design

The term FLOSS refers to Free/Libre and Open Source Software, a set of practices, communities and software distributions which are both free for various uses and open source (Steiniger & Hunter, 2013). Despite the fact that the implementation of FLOSS solutions at various stages of a GIS workflow supports a postdevelopment design of technology, such software largely preserves knowledge barriers to entry which risk to strengthen technological divides between those whose digital literacy allows its use and those who do not find it accessible.

The expanding reach of open data, volunteered geographic information (e.g. OSM) and free software is quickly growing the accessibility and use (also in remote) of geospatial data (Câmara et al., 2012; Foody et al., 2017). Despite its applications being beneficial to decentralised knowledge (Fisher & Myers, 2011), GIS democratisation also determines new contingent forms of technological exclusion given its complexity (Byrne & Pickard, 2016). Thus, such *differential empowerment* in practice conserves a colonising agency which easily leads to its use "because we can" (Fry, 2019, p. 298) without critically engaging with its design and application. A phenomenon which echoes with Fry's (2019) postdevelopment concept of *techno-colonialism*.

Furthermore, GIS workflows' logistical complexity and costs determine a steep technical learning curve for non-GIS specialists (Hao et al., 2014) and bound its practice to low-cost

internet-free software for low-resource groups (Fisher & Myers, 2011). Besides, the assumed digital dematerialisation of GIS knowledge creation rests on a technological environment requiring technological inputs, such as hardware, software and web services, which are associated with extractive practices and the depletion of natural commons (Caffentzis, 2019).

Even so, FLOSS design presents a high compatibility with postdevelopment in practice. FLOSS movements claim for freedom not just as accessibility but also as control over the structural design of software (Kishor & Ventura, 2006). Such design is articulated around an “open and transparent peer-reviewed software development process” (LibreOffice, 2010, p. 1) and calls for four fundamental freedoms: being able (1) to run the software, (2) to understand and modify it, (3) to redistribute it, and (4) to improve it and share modified versions (Steiniger & Hunter, 2013).

The social movements behind the main software in use for the following study (Ubuntu OS, LibreOffice and QGIS) are, to a different extent, part of a global alliance which rejects hegemonic practices in digital technology creation. Namely, the communities developing such software participate in a process that transcends militant particularism in a way that resembles a postdevelopment praxis which Temper et al. (2018) described as a framework of emancipatory and transformative alternatives across scales.

It may be concluded that a FLOSS workflow in GIS, regardless of its expanding accessibility, presents a marked complexity in learning and use and a variety of unintended agencies related to differential empowerment and its environmental footprint. Despite such limits, the design of the FLOSS environment recalls an anti-hegemonic praxis common across the postdevelopment critique.

5. Collective, emergent and relational:

Spatially organised knowledge for the pluriverse

After having explored the extent to which a FLOSS-based participatory GIS design workflow may meet postdevelopment in practice, the question arises of whether this could also generate its proactive engagement within policy information. The intuitions behind such forms of policy information are thus analysed in the light of the critiques moved to postdevelopment.

The aforementioned workflows allow low-resource community groups to engage in spatially organised knowledge for policy information (McMahon et al., 2017). They constitute an

engaging setting for the de-professionalisation of GIS practice, in line with Illich's de-personalisation of knowledge (Illich, 1975), meeting a growing debate in the contemporary postdevelopment literature (Bendix et al., 2020; Esteva & Escobar, 2019).

The meaning of 'participation' in GIS practice is often "neither a shared, unique, nor widely understood construct or concept" (Wise & Craglia, 2008, p. 391). Yet, to the extent that it can facilitate the visualisation and dialogue between situated forms of knowledge, its critical practice is leading towards a new paradigm of GIS knowledge: a *collective, emergent and relational* design aligned to Escobar's recent work (Escobar, 2018) on reimagining relationality within a postdevelopment design.

Additionally, the focus on negotiating subjects and the design of GIS work is in line with a major information of preanalytic choices while setting the narrative of a policy debate. Such an approach is also promoted as a transformative practice in evidence-based policy information under the name of *quantitative storytelling* (Saltelli & Giampietro, 2017). Hence, the process of participatory exploration of GIS practice allows to develop a shared consciousness of the thematic frames and data narratives concerning the inputs in use and, drawing a parallel to the literature of evidence-based policy information, "to respond to the factual-emotional basis of politics in a more holistic manner that at the same time embraces "'knowing,' 'doing' and 'being.'" (Umbach et al., 2018, p. 3).

Furthermore, this proactive nature of participatory GIS practice allows to support what Temper et al. (2018) identify as grassroot processes which dynamically engage the political agency of their work in *global-contextual* struggles. Hence, it provides room for visualising the limits to the charges of romanticism abstraction and of monolithic portray of 'standard development', which are often opposed to the postdevelopment discourse. Namely, when applied to policy information, the intuitions behind situated knowledge, participation, relationality, software freedom, and spatial organisation intertwine in "a universe of possible frames which is sensitive to the existence of power relations, of different actors, interests and norms" (Saltelli & Giampietro, 2017, p. 90), a characterisation that reminds the definition of pluriverse and postdevelopment provided above.

Concluding, the elements of de-professionalisation of participatory GIS practice leading towards collective, emergent, relational knowledge seem to constructively engage postdevelopment in practice within policy information. The shift towards pre-analytic policy information -through data narratives that simultaneously embody *knowing, doing and being-* can generate supporting evidence against the charges of romanticism and of a monolithic criticism of

'development' moved to postdevelopment, while escorting the individual in a progressive discovery of the political agency of information.

• • •

This literature review mainly explored the linkages and tensions between critical and participatory GIS and postdevelopment in practice, nonetheless, such a specific literature stream is hard to identify, if not absent. This could be motivated by both an high disciplinary identification of GIS geographers and a low 'quantitative' engagement of postdevelopment scholarship.

However, this investigation manifested the growing engagement of participatory GIS practice within the ontological and epistemological renegotiations necessary for the maintenance of a plural systems of knowledge and its growing interest for the relational nature of information. It has also highlighted that such practices are prone to unintended outcomes, semantic levelling of knowledge, and hidden data performativity often beyond the conscious use of a non-expert and low-resource user. Furthermore, it has identified the compatibility of FLOSS's anti-hegemonic design with postdevelopment in practice while acknowledging its complexity, costs, and embedded agency. Finally, it has pointed out how a de-professionalised practice of participatory GIS within the context of policy information could help to inform data narratives towards a more holistic concept of evidence, supporting in turn the proactive engagement of postdevelopment in diversified struggles against a contextual 'development' discourse.

Far from entirely addressing the broad horizon disclosed by the research question, this review has composed a spectrum of compatibilities and risks in order to engage in the participatory study with major awareness of the related agencies of *knowing, doing and being*. The answer about the degree of the workflow's embodiment of postdevelopment in practice is probably *to the extent to which the collective relational experience is a balancing drive for the emergence of knowledge*. Such an answer is contextually grounded a simplified universe of anglophone literature from the last two decades. Hence, the extent to which it possibly seems unsatisfactory may be related to an own mind's claims against the lost custom of situated knowledge which this study aims at, and in which light it should thus be understood.

Besides, the interrelations between critical and participatory GIS and postdevelopment in practice have poorly, if at all, been addressed in both literature traditions. It remains unclear

whether the recent 'holistic' turn of critical and participatory GIS and evidence-based approaches is mainly informed by a framework of a 'pro-pluriverse' situated knowledge or it follows other literature claims. In addition, the perception and use of postdevelopment in practice by policy makers is widely left unexplored, resulting in little elements to include in the early design of a GIS workflow for postdevelopment policy information.

All things considered, the making and visibility of alternatives to 'development' can benefit from collective processes of exploration and dialogue over FLOSS-based participatory GIS practice, provided that an equal effort is devoted to the unintended and embedded agency of the means in use. As reported by Pavlovskaya (Pavlovskaya, 2018, p. 52), given such a balanced care, participatory experiences reveal their proactive commitment towards concrete transformation:

Mapping spaces of possibility can keep social alternatives alive, nurtured, and cared for even while conservative neoliberal ideologies strengthen. In other words, mapping geographies of hope helps to incorporate them into forward looking social imaginaries.

II. Context, methodology & data: Addressing postdevelopment within participation and tools

In the chapter that follows, the incorporation of postdevelopment in practice into a GIS workflow is organised according to the selected context, to a series of methodological choices and to the data in use.

The research was carried out at the main secretariat of the Alliance for Food Sovereignty in Africa (AFSA) in Kampala, Uganda. All officers are equipped with personal laptops and have access to wi-fi, even though marginal limitations in the use of both technologies are imposed by power cuts and by the random instability of the internet signal.

The workflow was defined in association with all officers involved through a participatory approach and a wider collaboration was settled with two officers for knowledge sharing and for an improved accessibility of the workflow after the end of the internship.

Furthermore, the accessibility and transparency of the project is addressed through the software in use. The process is articulated through Free/Libre and Open Source Software (FLOSS) using the Linux operating system Ubuntu, the LibreOffice suite and the QGIS application.

The chapter is divided into three sections. Firstly, the theoretical background and context supporting the participatory research at AFSA are presented according to an African intuition of postdevelopment in practice. Secondly, methodological choices, participatory actions, software, audience and languages in use are addressed through a post-positivist strategy for GIS. Lastly, the heterodox variety of data in use for and produced by the collaboration with AFSA are described under the perspective of critical and participatory GIS as a continuum of qualitative-to-quantitative research.

1. Context:

AFSA's case for food sovereignty in Africa

The complex encounter of GIS and postdevelopment in Africa is not simply a matter of theory, it is indeed visible, for instance, in the pervasive development of open geographical data. An example could be found in the floating slum of Makoko in Lagos (Nigeria), a vibrant underground economy that historically articulated postdevelopment in practice through eviction resistance and self-organisation (Osuoka & Aremu, 2019), that faces the bottom-up development of OpenStreetMap through the partnering of volunteers and various local and global organisations (Marshall, 2021). Because of these and other phenomena spread across the continent, the concrete ground for an organised reflection on the use of GIS in a postdevelopment perspective is urgent.

In the following section, the peculiar nature of postdevelopment practices and theory in Africa is related to the work of the Alliance for Food Sovereignty in Africa, which was selected for the collaborative development of a GIS workflow. The positionality and characteristics of the organisation are presented while drawing on some contextual challenges.

Despite the body of postdevelopment literature coming from or concerning Africa seems to be poorly affirmed internationally (Matthews, 2017), the observation of praxis and practices alternative to development can reveal articulated and proactive efforts in contesting the discourse of development (Prosser, 2010). Furthermore, the 'desirability' of development in Africa, as portrayed by Matthews (2017, p. 2659), is entangled with a "desire for equality, dignity and redress". Hence, decolonising the imaginary about 'development' involves, in this context, recognising that the contextual integration or rejection of practices related to 'development' happen following different critical approaches, which in turn might not be easily adjustable to a systematic postdevelopment intuition.

A specific articulation of such an intuition is reflected in the advocacy work of the Alliance for Food Sovereignty in Africa: an NGO coordinating efforts for agroecology and food sovereignty promotion across the continent. As a matter of fact, AFSA depicts the "inextricable connections between climate change, deforestation and industrial agriculture" as "a prime mechanism of agrarian extractivism and extractivist development" fuelling globally "systemic, existential crises" (AFSA, 2021, p. 1). Yet, it articulates a proactive, critical engagement with 'development' without directly referring to the theoretical background of postdevelopment.

Being a network composed of other networks and stand-alone organisations, AFSA voice gathers “African food producer networks, African CSO networks, indigenous people’s organizations, faith based organizations, women and youth groups, consumer movements, and international organizations” (AFSA, 2020, p. 4). Hence, it gives expression to an evolving variety of stances from decolonising the imaginary around agribusiness technological fixes to reclaiming the agro-processing of African food within the continent and through ecological practices.

The organisation is almost completely run by African-born officers and it operates, directly and through its members, across more than fifty countries in the continent, while employing English and French as the main working languages. It was therefore selected as the partner for the creation of a web map workflow given its embedded nature in African systems of knowledge and the accessibility of the language to the researcher. The collaboration was then defined as a student internship of 10 weeks at the main secretariat, based in Kampala (Uganda), with the objective of mapping the case studies published by AFSA in its first 10 years of activity.

Nevertheless, a series of contextual challenges has to be outlined. Firstly, the officers involved in the process had limited or no experience in the use of GIS and FLOSS software. Thus, also on account of the limited time, the participatory approach was defined on the basis of negotiating objectives, processes and outcomes rather than on a direct involvement in the use of software, except for QGIS. Secondly, the broad representation of communities of interest and, at times, the vague geographical dimension attributed to a case study posed limitations to an effective and coherent simplification of the information through a map. Lastly, as broadly common in Kampala, the physical infrastructure where the research occurred were affected by random power cuts lasting from twenty minutes to a few hours and by the occasional instability of the internet signal, making necessary the support of batteries and of a mobile internet data connection for the continuity of the work.

In sum, the urgency of an organised reflection on the relations between a critical and participatory approach to GIS and postdevelopment was addressed through a collaboration with AFSA in line with a flexible understanding of how an intuition of postdevelopment in practice adjusts to the African context. Despite some contextual challenges, the critical engagement of AFSA with ‘development’ and its embedded capacity to represent African civil society were chosen as a fertile ground for the construction of a critical and participatory GIS workflow.

2. Methodology:

A post-positivist strategy for a GIS workflow

In order to move the theoretical discussion to its application, a methodological strategy was identified on the basis of: the knowledge of the researcher, the accessibility of the workflow and the negotiations with AFSA. The following section presents, firstly, the theoretical background at the origin of the thesis. Secondly, it describes the participatory actions through which the case study was articulated. Thirdly, it reports the choices over the software in use, and, lastly, it presents the target audience and language in use.

The study triggers with no specific predetermined hypothesis over the processual design of the workflow. Following a post-positivist strategy in line with the theoretical background presented in the previous chapter, the research attempts to define an accessible path in GIS for postdevelopment through the example of the creation of a web map. Thus, the methodology is not mixed but placed in a continuum between qualitative and quantitative aspects of critical and participatory GIS. The only predetermined input to the research consists in a set of three questions formulated by the researcher which have been iteratively redefined along the process:

How can GIS data inform the policy-makers' theory of development through a postdevelopment perspective?

To which extent can a FLOSS-based participatory GIS design workflow embody postdevelopment in practice?

What are the limits and potentials of FLOSS in supporting 'pluriversal' knowledge with regard to such a workflow?

Specifically, the second question was selected as the one to be addressed by the study and the collaboration with AFSA was defined. Furthermore, the methodological choices which are presented below were informed by elements of participatory action research. Hence, they should be observed in the light of a set of objectives that were drafted in the origin of the research and adjusted to the emergent needs manifested in the collaboration.

Three practical objectives:

- (a) To build an accessible GIS workflow in FLOSS for postdevelopment data visualisation.
- (b) To develop the workflow together with an organisation involved in postdevelopment advocacy.
- (c) To define an operative strategy to visualize *an enduring diversity of socialites* in GIS.

Three theoretical objectives:

- (a) To contribute to the academic literature reclaiming GIS accessibility for non-expert and/or low-resource user groups.
- (b) To develop the workflow within the perspective of postdevelopment policy information in Africa.
- (c) To conceptualise a critical and participatory GIS workflow in a qualitative-to-quantitative continuum.

Because of such theoretical background, the study of an accessible and participatory design for a GIS workflow was formalised around the creation of a web map of AFSA's case studies. Indeed, the creation of the web map supported the analysis of four categories of data: dialogues, data derived from participating in the NGO activities, AFSA case studies' data and GIS data.

The participatory actions simultaneously involved: (1) building the web map, (2) providing support with GIS for other visualisations (Figure 1) and (3) supporting the NGO daily activities. In particular, this latter allowed a better understanding of AFSA design of advocacy processes, further embedding the researcher in the working environment of the secretariat.

The collaboration was negotiated remotely with three meetings involving two officers. It was then carried out in presence following the three key actions presented above. Concerning the web map creation, three online meetings with the secretariat (also composed by some members not based in Kampala) were the occasion to negotiate the subject of the map, the data to be included and its visualisation as well as to evaluate the outcome. Furthermore, it is acknowledged that 4 officers covered the role of key informants in the process, even though the inputs received ranged from different other officers of the secretariat to other representatives of AFSA member organisations.



Figure 1: Example of a GIS visualisation developed at AFSA for advocacy purposes. The map represents the countries involved in the national dialogues and the regional study for an African Food Policy, an initiative targeting the creation of a continental framework for food policies at African Union's level.

Besides, given the aforementioned challenge of the officers' low previous involvement with FLOSS and GIS software, the study did not negotiate the choice of software used by the researcher but aimed at testing the accessibility of a selection of software. Specifically, it involved the use of: Ubuntu operating system (20.10, 'Groovy Gorilla'), the LibreOffice suite (7.1.2) and QGIS (3.18, 'Zürich'). Only QGIS was presented to the NGO and some basic knowledge was shared with two officers for the future update of the map.

The use of this software is motivated by the researcher's knowledge and habits, and it represents only one example of a FLOSS-based working environment. Firstly, the operative

system Ubuntu⁴ is one of the most popular Linux distributions. It is developed by Canonical Ltd.⁵ together with a community of volunteers and developers, and it comes with a friendly graphical user interface which requires a low interaction with its terminal for installing basic software.

Secondly, the LibreOffice suite⁶ is a community-driven productivity software distributed by The Document Foundation. It is cross-platform and it includes various office software among which the word processor (LibreOffice Writer | .odt), the spreadsheet (LibreOffice Calc | .ods) and the database software (LibreOffice Base | .odb) which were employed for this study.

Lastly, QGIS⁷ is the most common FLOSS software in GIS. It is cross-platform, community-driven, developed by volunteers and it allows for a wide variety of 'plugins' to expand its functionalities. Specifically, the study made use of the 'QuickOSM⁸' plugin for the download of OpenStreetMap data and of 'qgis2web⁹' plugin for the export of the QGIS project to a web map format.

Moreover, in order to investigate the functionality of the software within the context of this research, the audience of the map and working languages were collectively defined. Firstly, the geographical target community of AFSA was broadly outlined as the 55 members of the African Union (African Union Commission, 2020). Secondly, the target audience was identified in: the policy informants at African Union, Regional Economic Communities and national levels and the general public composed by AFSA members and other users. Hence, the main working language was defined as English and the translation to French was provided within the web map, except for the languages used by OpenStreetMap in its Standard Tile layer as reported in the next section.

In conclusion, this post-positivist methodological strategy for a FLOSS-based participatory GIS design workflow was organised on the basis of a set of objectives and actions adapted to

4 Ubuntu desktop distributions are accessible at <https://ubuntu.com/>. For the purpose of this research the version in use was Ubuntu 20.10, the one already in use on the researcher's laptop. Nevertheless, the distributions are periodically updated and, for instance, by the time this research was concluded new distributions were made available. It is generally recommended for a non-expert user to stick to the available LTS version (Long-Term Support) due to simplicity and stability of the system across years.

5 Canonical Ltd. is a UK-based computer software company, its profile is available at <https://canonical.com/>. It represents a clear example of how leading FLOSS projects not only belong to the not-for-profit sector but they could also be developed by for-profit organisations in collaboration with global communities of volunteers.

6 LibreOffice is a global community-driven and developed project of The Document Foundation (based in Germany). It is distributed under the Mozilla Public License v2.0 and its profile and releases are available at <https://www.libreoffice.org/>.

7 QGIS is a project driven by a global community of volunteers, and it is released under the GNU General Public License (GPL). Its profile and releases are available at <https://qgis.org/>.

8 The QuickOSM plugin's details and versions are available at <https://plugins.qgis.org/plugins/QuickOSM/>.

9 The qgis2web plugin's details and versions are available at <https://plugins.qgis.org/plugins/qgis2web/>.

the research context. An example of a set of common and accessible software was defined for the methodology, and target audience and working languages were selected in order to bound the collection and organisation of data for the creation of a web map.

3. Data:

Negotiations towards an integrated data approach

This study employed primary data from interactions and participation and secondary data from AFSA and external sources. The scope of data highlights the hybrid nature of critical and participatory GIS, which includes both the valorisation of the qualitative dimension of mapping and building new databases or employing the ones made available by other organisations. The following section will present the nature of reported interactions and negotiations, then, it will address the origin of internal and published data of AFSA and, finally, it will describe the use of geospatial data.

The first type of data are the 'interactions' generated by participatory observation and actions. They span from dialogues to specific data on AFSA derived from participation, and they were reported in a workflow diary. This latter was organised into daily sections containing three main elements:

1. The knowledge of AFSA derived from the active support of the NGO daily activities (e.g. graphic editing, cloud infrastructure, documentation, GIS visualisations, etc.) and the reading of AFSA internal reports and published documents.
2. The participatory observation of the working environment including email exchanges with different officers of the secretariat and the inputs received during spontaneous discussions developed in the breaks.
3. The constant face-to-face and virtual consultancy with key informants and the reporting of the aforementioned key meetings with the secretariat.

The second type of data corresponds to the information acquired in the process of cataloguing the case studies for their subsequent integration in the web map. A number of metadata available in the AFSA's site internal records were originally identified and reported in a database by the researcher (e.g. 'English title', 'French title', 'ISO code of the region', 'stable

link to the English version', etc.). Then, following piloting, collection and discussion over their visualisation, a subgroup of metadata was collectively selected.

A specific mention should be made to the attribution of the geographical dimension to each case study. Given the decision –explained in the next chapter– of representing each case study with a point, a strategy for simplification was agreed for those studies that did not report a precise location in the published document. Therefore, the specific fields locating the case study were created by the researcher according to the reported information from the text and to the consultation of the officers.

The third type of data corresponds to the geospatial data and the tile server¹⁰, both provided by OpenStreetMap (OSM)¹¹. While the data exploration led to the analysis of multiple open layers including the target community for AFSA (e.g. GADM (3.6), Natural Earth (4.1.0), ICPAC resources, etc.), the selected source of data was the QuickOSM plugin. This choice is explained by its flexible provision of up-to-date OSM data, its simplicity, its wide scope, its integration in the QGIS environment, and the collaborative, 'emergent' nature of the data provider in line with the theoretical background presented in the first chapter.

Along with the actual construction of the web map explained in the next chapter, a recursive process for the definition of the visualisation led to the discard of a part of the data or to their use only for processing purposes. Administrative layers were downloaded for all 55 target countries with the tag¹² *admin_level=2* for the national level and the tag *admin_level=3/4/6* for the regional level, according to the level shown in the standard server tile provided by OSM. Besides, the geopackage¹³ format (.gpkg) was used for storing the data, due to its capacity to integrate multiple informations in a single file, and for facilitating the use of data for other NGO activities.

The OSM database is a collaborative project following the 'on the ground rule'¹⁴ and providing geographical data and their descriptions in their local or official language, together

10 The OpenStreetMap's Standard Tile layer is the default OSM web map tile. It is hosted on an accessible server funded by donations. The Tile Usage Policy is available at <https://operations.osmfoundation.org/policies/tiles/>.

11 OSM is the acronym of OpenStreetMap, a global collaborative GIS database for building and sharing geospatial data. The database is available at <https://www.openstreetmap.org/>. It is promoted by the OpenStreetMap Foundation (OSMF), whose profile is available at <https://osmfoundation.org/>, and it is accessible under the Open Data Commons' Open Database License (ODbL), whose description is available at <https://opendatacommons.org/licenses/odbl/>.

12 In OpenStreetMap's data infrastructure, a tag is composed of a key and a value (*key=value*). The tagging community standards allow users to interact with the database and to download data according to specific features. The OSM's data infrastructure is described at <https://wiki.openstreetmap.org/>.

13 The geopackage format (.gpkg) is an open and platform-independent format for transferring geographical information. Its profile is available at <https://www.geopackage.org/>.

with a wide spectrum of translations in constant development. Thus, the labelling of countries and locations by the standard OSM Standard Tile server follows such a rule and corresponds to an exception to the language choice made in the previous chapter.

All things considered, the definition of the workflow used data of different nature, which requires a wide spectrum of qualitative and quantitative choices at different steps of their collection and employment. This shows how critical and participatory GIS relies on negotiations beyond a methodologically enclosed data approach and it expresses the relevant dependency of the research results on the contextual dynamics of participation and tools in use.

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This chapter highlights that post-positivist practice in critical and participatory GIS is in need of an urgent reflection over its contextual employment and over the results that it might generate. The African postdevelopment debate assumes multifaceted shapes and might not directly adjust in all its aspects to the international literature. Yet, it is in the nature of postdevelopment in practice to negotiate between contextual struggles and desires and global narratives in favour or against aspects of the 'development' discourse.

The research is openly informed by the researcher perspective on the use of FLOSS for the construction of a GIS workflow, nevertheless, it is articulated through participation and collective negotiation of objectives, audience, language, choices, data, visualisations and outcomes. This intertwined situation showed how the pre-existing knowledge and habits of the researcher could mix with the emergent and dialogue-based nature of interactions within an organisation. Thus, it allowed us to realise how a workflow design with no predetermined hypothesis is anyway bounded by the choices -even when collectively taken- made along the process.

In line with this discussion over the context, the methods, and the data necessary to the construction of a workflow for critical and participatory GIS, the following chapter will explore the results. It will structure the workflow in parallel to the participatory actions described above,

14 The 'on the ground rule' principle applied by OpenStreetMap refers to a -not straightforward- prioritisation of data as they appear from the perspective of someone physically living in a precise location. Further information concerning names, borders and boundaries, and names is contained in the position paper of the OpenStreetMap Foundation (OSMF) on *Information for officials and diplomats of countries and entities with disputed territories*, which is available at: <https://wiki.osmfoundation.org/w/images/d/d8/DisputedTerritoriesInformation.pdf>.

taking the AFSA's web map of case studies as an example to guide the reader in the autonomous interpretation of useful elements of the workflow design.

III. A participatory GIS workflow: Visualising agroecology in practice across the African continent

As outlined in the previous chapters, the intricacy of GIS exposes user groups to various negotiations, unintended outcomes and reformulations over objectives, inputs and tools in use. The following chapter provides a list of GIS practices organised according to a critical and participatory approach, attempting to embody a practice of postdevelopment. Each step of the list reported below does not strictly belong to its ordered position, given the recursive and contextual nature of participatory GIS. Yet, this simplification may allow a non-expert user to get oriented in its organisation. Furthermore, the collaboration with AFSA will be presented along with the description of practices to draw over the capacity and risks of working with GIS within postdevelopment in practice.

Before developing the list and describing the choices and negotiations involved, a brief introduction to the sole technical process followed for the creation of the final version of the AFSA's Web Map of 78 case studies (AWM) is provided below.

The final web map is composed by 5 elements: the table of metadata of the case studies and 4 point layers of case studies, one for each of the 4 key focuses of AFSA's case studies ('Seed Sovereignty', 'Pastoralism', 'Land and Soil' and 'Agroecological practices'). Initially, the geographical dimension of the AFSA target community was built integrating OSM administrative data for each target country in a common geopackage file, which was then converted to a layer of centroids for the regions. This latter allowed us to generate a table with the attributes of each 'region' joined with its corresponding national attributes (keeping only the ISO 3166-2¹⁵ codes and the names of the region and of the country in English, when provided, and in OSM default language).

15 The ISO 3166-2 codes represent the main subdivision of countries (e.g. states, regions, districts, etc.). They are provided in the second part of the ISO 3166, a standard published by the International Organization for Standardization (ISO). Given their integration in the OpenStreetMap dataset, once the geospatial information was downloaded, they represented a unique identifier at 'regional' level.

Meanwhile, the case studies' metadata were collected with a database form created in LibreOffice Base and then exported in a .csv table. Specifically, with the support of the table of OSM attributes used within the database, a geographical dimension was assigned to each case study with the ISO 3166-2 code of each region. This allowed us to automatically integrate the names of the regions and their country in the case studies' metadata by manually selecting the English language when available and the default one for the other cases.

The visualisation was built on four point layers using a pin as a symbol for each case study. Given the low number of regions containing more than one case study by key focus, each layer was derived from the geopackage of region centroids. The field containing case study IDs was joined using the ISO codes of the geopackage and the primary ISO code of each case study as a 'join field'. Then, few manual edits were done for the case studies with the same focus area and the same region and for case studies involving more than one region points were added manually. Subsequently, the point layers were reduced to the records with a non-null value for the field containing the case study ID and they were joined to the .csv table of the case studies' metadata, using the case study ID as 'join field'.

The original layer with the centroids of regions was then removed and stored for future edit (by copy paste of the feature of interest). The metadata were added to the project's and layers' properties to adjust the information visualized and the configuration of active layers in the web map. Finally, the project was exported through the plugin qgis2web compiling the Leaflet settings, and making it ready for upload to the web hosting. The web map (Figure 2 and 3) will be available at <https://afsafrika.org/> once the site will have gone through some maintenance which is on-going at the time of the publication.

While this brief description presents the GIS practice in its technical nature, the following one aims at addressing the GIS workflow as a *socially constructed set of practices* studded with choices, leading the reader through the realisation of the space of postdevelopment practice intrinsic to those practices.

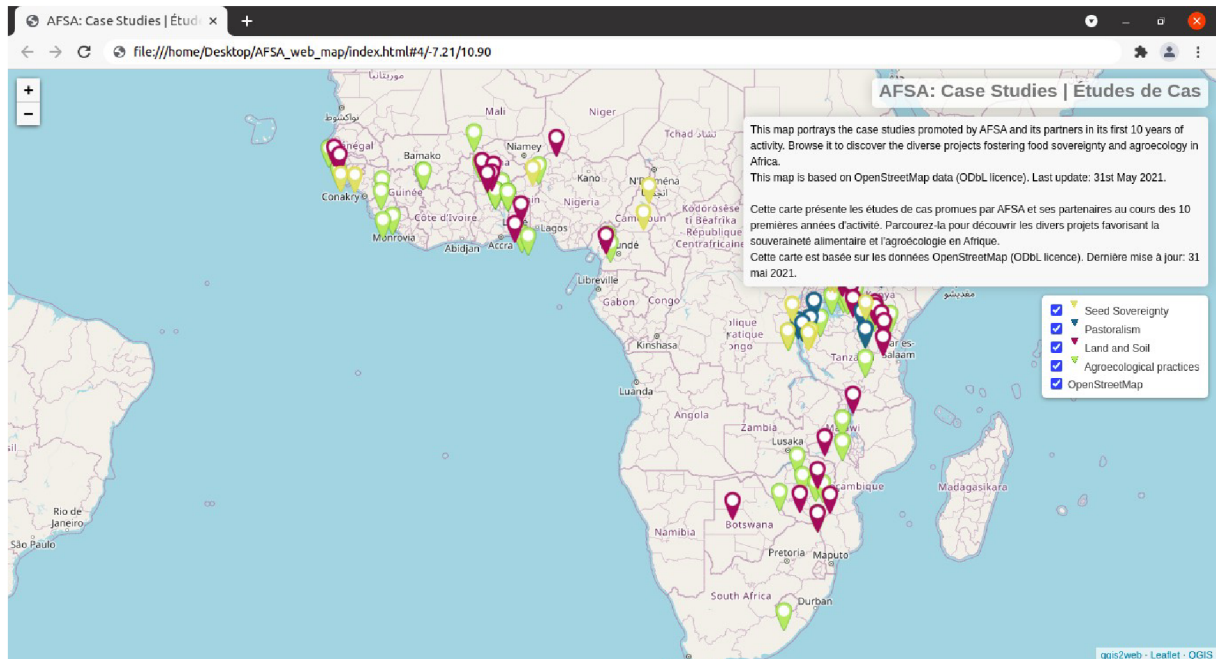


Figure 2: AFSA's web map of case studies, global view of the case studies.

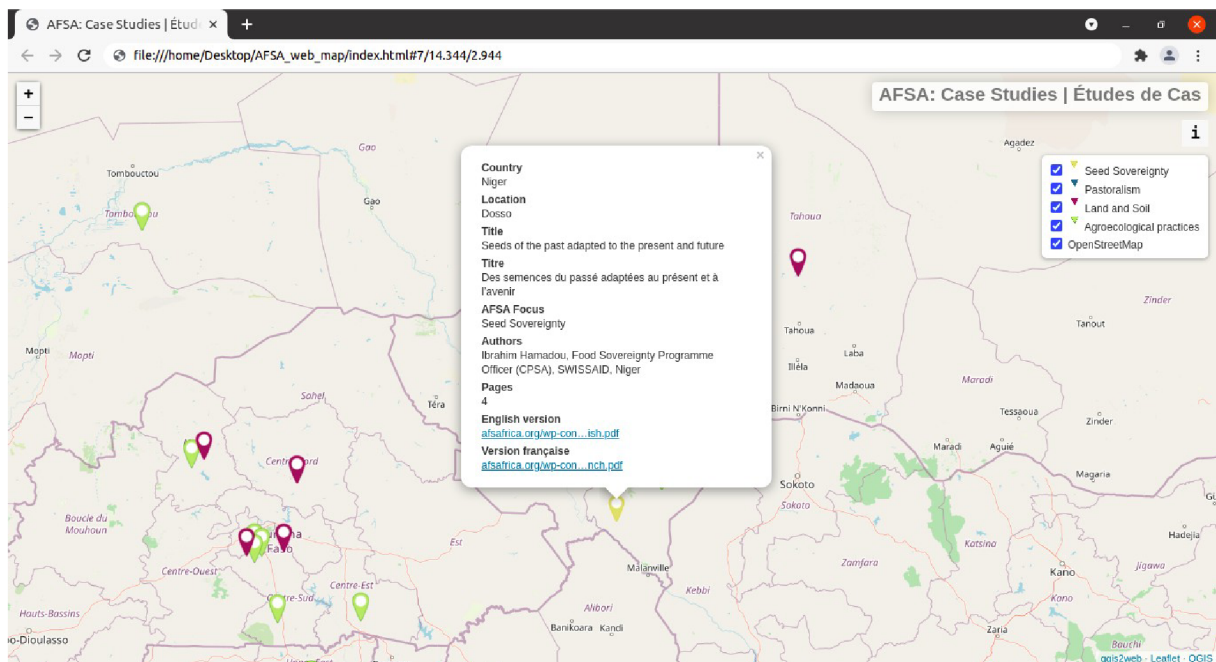


Figure 3: AFSA's web map of case studies, detail of the activation of a pop-up for a case study localised in the region of Dosso, Niger.

Workflow summary:

1. Building a collective objective.
2. Identifying a *geographical definition for the community of interest*.
3. Defining a target audience.
4. Exploring data.
5. Discussing the geographical integration of data.
6. Piloting possible visualisations.
7. Piloting data collection.
8. Collecting data.
9. Cleaning data.
10. Researching visualisations as a collective.
11. Integrating all data in the project.
12. Exporting the results.
13. Discussing the output.
14. Publishing and updating.

All the practices exposed in the list are articulated on a common folder structure that helped the organisation of data and the recording of the process, and the naming of files never included spaces or special characters to avoid incompatibilities. The folder for each task, which might be composed of more than one step of the list, is structured as follows:

- **Input folder:** it contains all the raw data and other input documents.
- **Output folder:** it contains print layouts, web map exports and other output files.
- **Processing folder:** it contains the layers used as a step of the process (saving a layer is recommended to avoid losses due to system crashing).
- **Workflow folder:** it contains .txt, .docx or .odt files providing information on the project, on the methodology followed and on metadata of the layers in use. It is also a suitable location for any other documentation in use.
- **Project file:** it is the .qgs/.qgz project file for QGIS or the .odb database file for LibreOffice Base, this was the only spare element left outside any folder.

Given such a data management strategy, which only represents an example of organised data storage, all the following practices are presented.

1. Building a collective objective.

At the origin of a GIS workflow, the negotiation of topics, processes and desired outputs involves questioning the need and the use of a GIS visualisation or analysis. This may involve modifying the original intentions, intuitions or research questions in accordance to the emergent needs which arise from the interactions within a community. For instance, during the initial interaction with AFSA, the researcher's willingness to map policy alternatives and the need of the NGO to facilitate an interactive access to its published case studies on agroecology led to the common willingness in creating a web map of these latter. Therefore, the objective was shaped by a synergy between informing policies through situated expressions of agroecology and organising spatially their visualisation.

2. Identifying a *geographical definition for the community of interest*¹⁶.

As claimed by the literature (McMahon et al., 2017; Wainwright & Bryan, 2009), the creation of a map may both increase social fragmentation or support community building. Whether the map is aimed at representing an own community or addressing a target, its geographical definition is not self-evident: it requires to perform informed choices on the geographical inputs and on their visualisation (e.g. their coordinate reference system). The selection of the OSM administrative units (via 'QuickOSM') of the African Union's 55 Member States as a basis for the AWM construction focused the attention on the target audience while losing ground on a less heteronormative representation of territories. In this sense, it highlights how postdevelopment visualisation may adjust to local practices and targets, and how it is tightly linked to the simplicity or accessibility of a process compared to its alternatives.

¹⁶ This expression is taken from the 'Step 1' of the GIS workflow theorisation by McMahon et al. (2017).

3. Defining a target audience.

The creation of a map, as any other act of communication, is informed by its target user's characteristics and literacy. The negotiation between presenting a pluriverse of systems of knowledge and crafting a comprehensible medium influences the choice of data, technology, language and design. An example is given by the AWM's language choice: the diverse labelling of the tile layer in the OSM's default local language is balanced by accessible information in English and French for the rest of the web map content. Yet, the equilibrium between stimulating the decolonisation of the imaginary and losing the target attention remains of delicate concern. Thus, the consideration over targeting should simultaneously address the target needs and embrace its data literacy in a form that considers a own's target lived reality (Tygel & Kirsch, 2016).

4. Exploring data.

From the perspective of non-expert and/or low-resource GIS users, the composition of a map relies on their capacity to generate, organise or gather data. On the one hand, a map does not need to be 'fully statistical' to be informative. For instance, the AWM's main content is generated by the collection (via LibreOffice Base, in Figure 4) of the metadata of the published case studies. On the other hand, because of the outdated nature of other open administrative layers explored (e.g. GADM, Natural Earth, etc.) and of the complexity in managing OSM data in other formats (.pbef/.osm), the more accessible path for obtaining geospatial information was identified in the manual download of countries via QuickOSM (Figure 5). Both examples spotlight how creativity and limitations in data exploration may influence all successive steps of a GIS workflow.

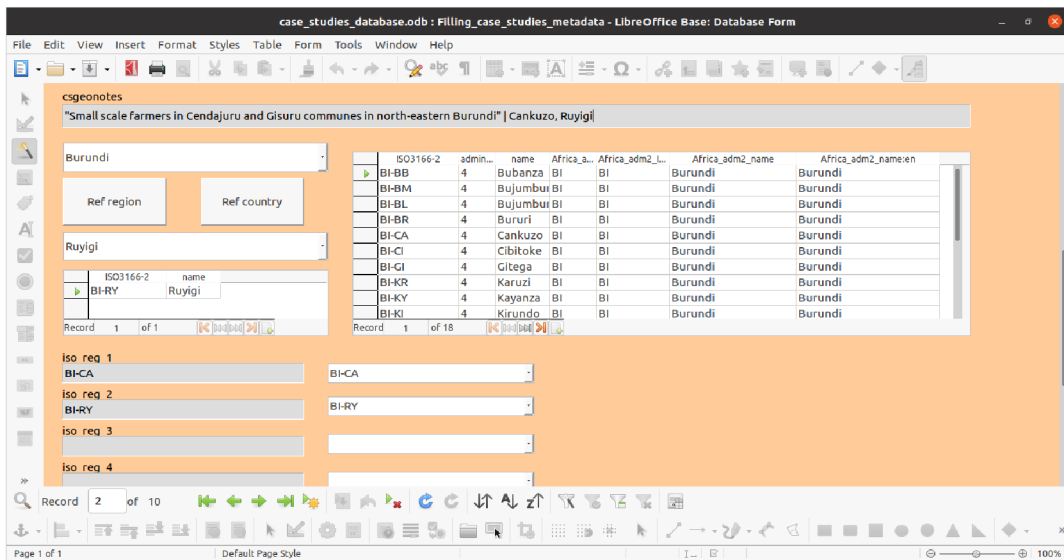


Figure 4: Form in LibreOffice Base created for the collection of the case studies' metadata, detail of its section concerning the attribution of a geographical dimension to each case study.

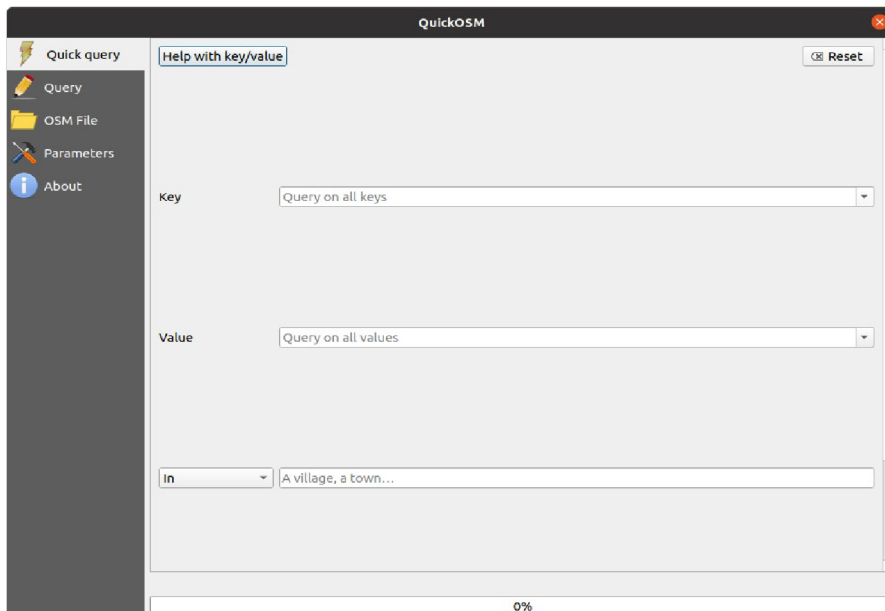


Figure 5: Data download interface of the QuickOSM plugin on QGIS. The 'Key' and 'Value' fields compose a tag which allows to identify and download all the elements of the OSM database with such characteristics. Besides, the field 'In' narrows the search to a specific area of interest.

5. Discussing the geographical integration of data.

As explored in the first chapter, good intentions do not avoid the subversion of a map message or the hijacking of the working imagination. The simple integration design between non-spatial information and the geospatial one carries this risk. Indeed, the AWM construction process arrived at the discussion of step 10 of this list as a visualisation based on administrative units divided in thematic colours with (possible) multiple pop-ups of the case studies for each unit, only to convert, at that time, to simpler thematic point layers with possible multiple points for each region. Thus, the use of ISO codes for the identification of the region became inadequate when the new strategy was redefined. This required the manual addition of points, making evident how a previous collective discussion of the geographical integration of the data explored might have smoothed the workflow.

6. Piloting possible visualisations.

Finalising a plan for the collection of data (including their coding, extensions, etc.) depends on their future use. Indeed, piloting the visualisation of data may modify the way in which they are collected. For instance, while constructing the AWM, the visualisation of the case studies divided in the four AFSA key focuses revealed that one of them ('Agroecology') needed to be reformulated because it broadly encompassed the other 3 focuses in its definition and in its application. Therefore, in the field 'AFSA_key_focuses' the value 'Agroecology' was changed in 'Agroecological practices' and its scope was reduced to those case studies that were not tagged under any other key focus.

7. Piloting data collection.

Piloting the collection of both 'non-spatial' and geospatial data may lead to a reorganisation of the planned visualisation options, for instance, by revealing that some use is not possible or not fully supported. For example, the initial table of metadata for the case studies included the publishing day, but, due to the restructuring of the site in 2019, the original day was not available for the great majority of the studies. Thus, the day was identified as a beneficial record to be included in the NGO's future standards, but it was removed from the pop-up. Verifying

where 'the plan falls short' unveils unaware assumptions leading users, while it builds a relation with evidence that goes beyond its extraction.

8. Collecting data.

Whether it concerns geospatial layers, statistical datasets or cataloguing internal data, the actual collection may entail choices and negotiations that are an integral part of a critical and participatory workflow. The recursive nature of such a practice benefits from discussion and information sharing. This insight is supported by the experience with the OSM's data download which led to discover that the region of North Kivu (Democratic Republic of the Congo) and the Kiryandongo district (Uganda) could not be retrieved from the database. After some interaction on the Telegram channels¹⁷ *OpenStreetMap* and *OSM Africa* and an email exchange with the OSM's Data Working Group¹⁸, the polygons and their tagging were restored thanks to the work of OSM local contributors. This experience shows the relational nature of questioning data in a post-individualistic science fashion.

9. Cleaning data.

Even though data planning and piloting could optimize the collected data. A further passage may involve their integration and the removal of useless data, probably the more transversal process of the workflow. The proactive simplification of mapping makes visible how data are a situated representation of reality, thus they involve choices. The labelling of places, for instance, is provided by OSM in a variety of languages depending on the presence and activity of translators. For the AWM, only default and English labels were kept to avoid loading unnecessary data and losing the focus, at times, in dozens of columns of the tables of attributes of each layer (Figure 6). As long as these steps are recorded, for instance in workflow notes, they represent an informed approach open to evolving judgments.

17 A list of Telegram channels dedicated to OSM topics is available at https://wiki.openstreetmap.org/wiki/List_of_OSM_centric_Telegram_accounts.

18 The OpenStreetMap's Data Working Group is delegated by the Foundation (OSMF) to deal with a series of infringements, disputes or research.

The screenshot shows a QGIS table window titled 'Burundi_OSM_adm4' with 18 columns and 18 rows. The columns are labeled with language codes and 'official_name'. The rows contain data for various regions, with row 13 showing the Gitega region in multiple languages.

	name:ru	name:ar	name:az-Arab	name:azb	name:de	name:el	name:fa	name:fr	name:ks	name:ur	official_name	official_name:ar	official_name:de	official_name:fa	official_name:fr	official_name:ur
1																
2																
3																
4																
5																
6																
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13		قیتھا	قیتھا	قیتھا	Gitega	قیتھا...	گیتھا	Gitega	گیتھا	گیتھا	Province d...	إقليم قیتھا	Provinz Gitega	استان گیتھا	Province de Gi...	گیتھا صوبہ
14																
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Figure 6: Table of attributes of the administrative regions of Burundi at download ('admin_level=4'), detail of the name translation fields mainly filled for the sole capital region.

10. Researching visualisations as a collective.

The shared discussion over data visualisation and analysis options may lead to a simplification or reorientation of the workflow. The participation in a variety of activities at AFSA allowed to define, besides the shift towards a point-based visualisation, two other contextual objectives: avoiding information overload and balancing the emotional understanding of colours according to their political and cultural meanings. Both inputs can be said to be basic principles of map design, yet they acquire their local articulation only through discussion and common experience.

11. Integrating all data in the project.

The integration of data may finally happen via 'relation', 'join', edit, etc., on the basis of the geographical integration identified at step 5. Commonly, if a unique field is shared by more than one source of information, it is enough to optimally aggregate data in a unique project. Yet, for

more complex data structures (such as one-to-many or many-to-many relations), the use of 'relations' in QGIS might make the case. For the AWM, it was established to use a simple join and some manual edits, following a data structure that would allow a simple access to update the map autonomously in the future.

12. Exporting the results.

Once the project is completed, the design of the results still involves a number of choices as well as it might be limited by software capacity. Exporting a GIS project can produce images, documents, web pages, GIFs or even videos. In any case, the export necessitates the integration of metadata, settings and design options to the project file and layers, or to print layouts and reports. For instance, when exporting a web map in QGIS, the 'Metadata' section of the 'Project properties' allows inserting basic information such as title, author, abstract, etc. Besides, the section 'Data sources' in 'Project properties' and the sections 'Fields' and 'Attributes Form' in each 'Layer property' allow to modify the information, capabilities, configuration and labelling of the elements of a web map.

13. Discussing the output.

Once a map is finalised, the interpretation phase discloses more extensively. Discussing the exported results with the community of interest or the acting community not only enables the cross-check of its interpretation, with a possible return to some modifications, but it also provides a common agreement on how this should be presented. In fact, when the first export draft of the web map was discussed, it included the point layer for the case studies and a layer of polygons to visualise the extension of the territorial scope of AFSA's research (Figure 7). Nevertheless, the need for a straightforward presentation of the case studies led to the removal of the second layer. Simplicity is an acknowledged principle of mapping, but it is also an informing element of postdevelopment practices which translates in the collective ownership and influence over a system of knowledge as much as over a specific expression of knowledge within a community.

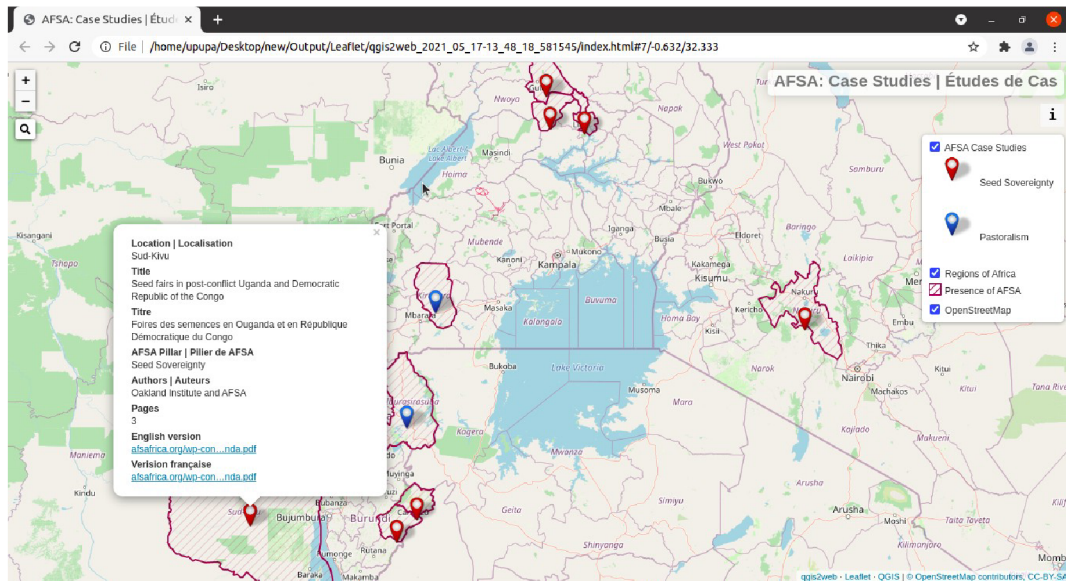


Figure 7: AFSA's web map of case studies, detail of a draft output including both a point layer for the case studies and a polygon layer for the territorial scope of AFSA.

14. Publishing and updating.

Lastly, the refined output can be published, and it may require a strategy for its future update. On the one hand, the metadata of a map should include the credits for the data in use (e.g. "This map is based on OpenStreetMap data (ODbL licence).") and possibly identify the precise authors or the acting community. Furthermore, in the case of a web map, some web hosting space should be available. This makes clear how a dematerialised GIS output can be powered by an active use of tangible technology, in this case of the server hosting it, and, therefore, it is associated with an ecological footprint not just at the user side, but also at the provider's one.

On the other hand, a published output might be a living map evolving in time, hence a strategy for its future update could include the training of some peers in the community for the active manipulation of the map. In the case of the AWM, GIS knowledge sharing was focused on two officers and the overall design was influenced by the capacity to autonomously modify the map, a recurrent need expressed in collective discussions.

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In conclusion, this chapter described the same workflow in its technical nature and in its conceptual organisation, showing how both are constitutionally intertwined in a process of negotiations and choices. It showed how the inputs for the decision making around various steps of the creation of a map involve a constant dialogue between the users and the community they represent. The complexity and limits of a number of steps were clarified and the frequent necessity of changing the planning of a visualisation has been explained.

Furthermore, these results show how the practice of postdevelopment in GIS is not limited to the topic, the perspective or the visualisation in use. Yet, it constitutes a constant attention and cooperative behaviour that might relate not only to an own community, but also to institutions or groups providing inputs and technology in use, such as OpenStreetMap or QGIS. Thus, the practice of postdevelopment within GIS is a transversal effort which unavoidably comports the development of a collective imaginary around a map and the adjustment of its theoretical background to a contextual expression and capacity.

IV. Discussion

In this last and fourth chapter of the thesis, the main findings of the workflow will be presented in the light of postdevelopment as a collective practice. First, the intuitions behind ontological and epistemological renegotiations, the contextual dimension and the rematerializing practice of the workflow will be presented. Second, the main methodological outputs will be analysed in terms of relationality, self-analysis and software learning. Third, the main findings over an informed and cooperative approach to the management of the data in use will be developed in connection to its limitations and to data agency and data planning. Lastly, the role of sharing experiences within and outside the workflow will be related to the interpretation of the chained, collective process of creating a visualisation in GIS. This in turn will describe how the proactive engagement of contextual 'intuitions' can be defined, to a certain extent, as a postdevelopment practice.

Intuitions

The list of practices embeds some principles of mapping developed through participating in AFSA daily activities and through the creation of the web map. Such 'principles' have the connotation of 'intuitions' under this study's perspective of situated knowledge. They can be summarized by three main aspects of a critical and participatory GIS practice: negotiation, contextual critique and 'rematerialization'.

The workflow displays how ontological and epistemological negotiations are a transversal issue to the whole process. From the researcher's personal renegotiations over the research questions to the structural shifts originating from the visualisation discussions, a critical and participatory GIS process partners with the decolonization of users' imaginary towards a form of post-individualistic knowledge definition and creation. Furthermore, in line with Escobar's work (2018), this supports the bypass of dualism as a common operative strategy in favour of a pluriversal structure of meaning.

Besides, the articulation of mapping objectives and inputs in use reveals that the nature of the critique to 'development' does not organise against a monolithic practice. Even the

targeting and data choices spotlight how a critical approach to 'development' could involve heteronormative spacial visualisations (such as nation-states) combined with practices that are 'alternative to development'. In this sense, the AFSA's critique of agricultural industrialisation, extractivism, raw material export, etc., converges in a postdevelopment practice 'adjusted' to a contextual critique of 'development'.

Nevertheless, the intellectual speculation over the definition of postdevelopment in practice should be balanced by a conscious rematerialization of GIS practice. On the one hand, technology, software, data, internet and infrastructural needs are evidence of material and ecological limitations to its use for postdevelopment advocacy. On the other hand, the continuous analysis of their unintended agency and complexity manifest how GIS practices and technology remain today largely beyond a conscious use for a non-expert and low-resource user. This was further reflected, in the case of the AWB, in the dependence of the project on the researcher 'monopoly' on GIS knowledge and in the limited technical involvement of the officers.

In sum, the intuitions derived from the workflow processes testify the high intellectual compatibility between a wise use of such workflow and postdevelopment in practice, while they caution against the idealisation of a shared, 'dematerialised' and controlled GIS practice.

Methodology

Once established the aforementioned intellectual compatibility, the workflow is then taken in its applied dimension. The results are discussed in the light of: the relationality of post-extractive methods, the structuring of a reflexive process, and the limits and commitment necessary for the software environment in use.

The structuring of a postdevelopment GIS methodological approach pivots on the relational nature of information aiming at post-extractive knowledge. Namely, it relies on the frequent discussion of the steps and decisions made and on sharing experiences within a community to develop the contextual meanings of principles such as simplicity, colour implications or overloading information. In this sense, Wainwright & Bryan's claim (2009) that maps produce communities through the delineation of relationships can also be observed in the cooperative effort of adjusting personal intentions to shared experiences and target needs.

In addition, the definition of a critical and participatory GIS workflow is rooted in the structuring of a user's reflexive process. In this case, the workflow diary sustained the reporting

and subsequent analysis of community interactions and discussion inputs. This made clear how biases, such as the researcher's habit towards thinking in terms of administrative units as polygons, would not lead to a straightforward visualisation within the AFSA's advocacy for agroecology. Hence, a GIS design for postdevelopment necessitates a strategy to crystallize the emergence of ideas and their analysis across the working steps.

However, as already stated above, the accessibility of FLOSS tools for a non-expert user remains a major limitation to an informed approach within postdevelopment in practice. For instance, despite their collaborative and anti-hegemonic design, the researcher's personal experience and knowledge sharing around Ubuntu, QGIS, LibreOffice and OSM, supports the literature, acknowledging a steep learning curve in software knowledge and data use for a non-expert GIS user (Hao et al., 2014). If, on one side, the communities behind such software support the resolution of problems and stimulate the acquisition of the necessary knowledge, on the other side, the poorly informed use of software exposes the user to broad unintended agencies.

In a nutshell, a FLOSS-based participatory GIS design workflow can effectively stimulate the ownership and understanding of the mapping process, yet, pursuing the representation of postdevelopment radical critique within GIS calls for an intense methodological exercise of relationality, self-analysis and software learning.

Data management

The data in use constitutes a second foundational applied element of a relational and collective workflow, and of its outcomes. In this section, the characteristics of FLOSS that drive data choice are analysed in connection with a critical behaviour towards the use and planning of the latter one.

Firstly, the management of data across the different steps of the workflow has exposed the complexity of FLOSS and the limits in the quality of free up-to-date data. A non-expert user may face a situation where the data choice is driven by its capacity to interact with the software or the database in use, nevertheless, the community channels of FLOSS and of collaborative open databases can support the resolution of such issues. Besides, some structural needs for the creation of a web map were made explicit, according to a conscious rematerialization of GIS

practice, namely, the potential need for an accessible tile server and the continuous need for web hosting provision.

Secondly, the workflow composition meets, at different steps, a postdevelopment practice in encouraging the emergence of the embedded agency of data. Specifically, it recalls the constant record of choices through workflow notes (e.g. name fields deletion) as well as the transcription of community interactions and experiences. It also goes beyond the classification of data as 'corrupted', interacting, when possible, with the community supporting their creation. Besides, it critically assumes choices over the semantic levelling of knowledge and it recognises the unintended outcomes derived from hidden forms of data performativity (e.g. the researcher's erroneous push on administrative regions initially leading the visualisation).

Lastly, the workflow states the relevance of planning for limitations. From discussing the geographical definition of a community and the geographical integration of data to piloting visualisations and data collection, all these steps include a constant look at its subsequent needs and may reveal that some of the categories (e.g. AFSA key focus) and data (e.g. publishing day) in use might need to be reshaped or removed. Furthermore, planning for limitations also involves accounting the future update of an output, possibly modifying data structures towards arrangements that are accessible to other people of the own community.

To sum up, the complexity, limitations, structural needs of the technology and data in use may act as a driver in the choice of data, which can be balanced by the interactions with the communities that support their provision. Besides, the critical engagement with and record of the choices made along the process, according to a forward-looking sustainability, allow users to unfold the emergence of the agency of data and to plan through discussion and piloting.

Visualisation & interpretation

In this last section, the antithesis between visualising and interpreting is dismantled by explaining how the shared experience, the flexible definition of the workflow, and the application of postdevelopment 'intuitions' do not uniquely capture an ideal set of practices.

Visualising a plurality of systems of knowledge was shown to be founded on sharing common experiences within and outside the specific experience of the workflow. The researcher's support in the NGO's daily activities and tasks informed the generation of contextual mapping principles such as straightforwardness, simplicity, 'development critique', agroecology, etc. Hence, the

results seem to suggest that revealing *already existing alternatives* (Klein & Morreo, 2019) cannot ignore an active, equal partnership within the community contexts where those alternatives are generated. In this sense, de-professionalising GIS practice refers to embracing all steps as a collective practice, and, in turn, to recognise what the critical academic literature pictures as an inconsistent divide between the *researcher* and the *researched community* (Wynne-Jones et al., 2015) or between the *academic* and the *activist* working attitudes (Russell, 2015).

Besides, all steps actively involving visualisation call for a constant consideration of the characteristics and display format necessary at subsequent phases. From the phase of data exploration, when the tile layer was identified, to the data integration in a unique project, when a 'join strategy' was performed, all steps benefit from accounting for the characteristics of the final result through constant piloting of the subsequent actions. Thus, the workflow is not really divided in watertight compartments and ordered as in the list, but it is chained in practice with the testing of related steps.

Finally, the collective interpretation of the visualisation, performed at different steps, suggests that promoting a postdevelopment workflow, as much as a postdevelopment policy, is an ontological false provided that it cannot be uniquely captured by a specific set of ordered practices in GIS. The study rather offered a space for 'dialoguing over postdevelopment' as a practice within policy information and critical and participatory GIS. Furthermore, the research showed how applying intuitions such as relationality, emergence, non-dualism, radical reflexivity and negotiation, could reveal the proactive engagement of postdevelopment within a participatory experience. Thus, it could concretely support the promotion of *forward looking social imaginaries* (Pavlovskaya, 2018).

All things considered, this section highlights that a common visualisation within postdevelopment research, and therefore a negotiated perspective, lies on shared experience and on embracing all steps as a chained, collective process. The participatory visualisation of *already existing alternatives* to development is thus informed by a flexible workflow and by the proactive engagement of postdevelopment 'intuitions' within the GIS practice.

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This chapter summarized the main findings of the workflow while assessing the extent to which it embodies a practice of postdevelopment. Intuitions, methods, data and visualisations show that the proactive engagement of postdevelopment requires: (1) contextual negotiation, (2) the exercise of relationality, self-analysis & software learning, (3) cross-actors interactions, planning & process recording, and (4) shared experiences, flexibility & the proactive engagement of postdevelopment 'intuitions'.

The study thus delineates a de-professionalised GIS practice which aims at an equal partnership between GIS users and the community where they operate. Hence, the 'participatory' dimension assumes the meaning of the researcher participating in a community rather than the researcher providing space for participation to community members. Under such an approach, postdevelopment in practice assumes a *collective, emergent and relational* nature and, thus, it facilitates the dialogue over the critiques and alternatives to 'development' which this participatory workflow aims at.

Conclusion

This research has shown the fundamental role of negotiation in GIS practice within an individual's own understanding of a process and interpersonally. As displayed by the intricacies of the workflow, even having access to free technology and data, the spectrum of choices that arise from a workflow requires to build an incremental consciousness of GIS practices, and to maintain a constant dialogue with the community where the user is based. In this case, the web map creation at the Alliance for Food Sovereignty in Africa allowed the delineation of an operative strategy in connection with postdevelopment in practice.

This study structures a participatory GIS workflow in a set of **14 chained, collective practices** employing **four main technological resources**: Ubuntu operating system, LibreOffice suite, QGIS and OpenStreetMap. It identifies the relevance of **sharing experiences**, within and outside of the workflow, with the community where a user operates. Namely, it explored the **ontological and epistemological renegotiations** led by the **contextual 'intuitions'** which originates from participating in the NGO's daily activities and from **discussing and piloting** the workflow. Specifically, the participatory dimension was articulated on: objective, geographical definition, target audience, data integration, visualisation and output interpretation.

Besides, the research provides examples on how the choices involved in the creative process are exposed to the **unintended agency** of data. Furthermore, it clarifies how this latter could be driven by the **complexity of FLOSS instruments and open data** in use. Nevertheless, the communities backing these instruments and data are shown to be reactive to a **collaborative resolution** of problems or provision of information. It is indeed through collaboration, and through acknowledging the **concrete limits and needs** involved in a GIS workflow, that such a practice **rematerializes** according to a **post-positivist and post-extractive** form of knowledge and evidence.

On a methodological ground, the three most demanding commitments are the radical employment of **relationality**, a structured form of **self-analysis** and the extensive time spent on **software learning**. Under such three conditions, the participatory workflow is the vehicle of the **emergence and integration** of a plurality of systems of knowledge. Moreover, the content, the visualisation, and the tools in use characterize this workflow as a practice of postdevelopment

that adjusts to a **contextual critique of 'development'**, while expressing the **proactive engagement** of a critical theoretical discourse in a concrete web map.

As a result, on a practical ground, a FLOSS-based participatory GIS design workflow can assume the traits of a postdevelopment practice to the extent that it does not disregard the embedded limits, agency and complexity of the tools and data in use. Indeed, this study allowed the construction of an accessible GIS workflow, within the perspective of postdevelopment and of the enduring diversity of knowledge. Yet, it neither provides the extensive documentation required for a proficient management of the same tools and data, nor it was based on a shared use of software with the officers involved.

On a theoretical ground, the workflow is a friendly resource for non-expert and low-resource users grounded in the perspective of policy information in Africa. Furthermore, the interacting nature of qualitative and quantitative information spotlights that a critical and participatory use of GIS requires users to understand the creative process as a methodologically integrated (or post-dualist) approach.

Given the concise nature of the present analysis, a number of limitations were identified. First, this study is built on anglophone literature and it uses English as the main language of interaction, despite being a secondary language both to the researcher and to the rest of the community where the study occurred. In addition, English and French are the main operative languages on which the case study visualisation is articulated, thus, a semantic levelling of knowledge is operated at such a level.

Second, this study is built on a practical approach rooted in standard Cartesian geography, even though, it does not point at this kind of geographic representation as more informative than others. Third, the quality of geospatial data in use and the complexity of the FLOSS environment requires some interaction and expertise, which may demotivate and disorient a non-expert user, or which may simply not meet the data and software literacy of the user. Fourth, the creation of a web map may comport costs or rely on the external provision of technology, for instance in relation to the use of tile servers and of a web hosting.

Despite the aforementioned limits, the study organised an accessible participatory GIS workflow via FLOSS instruments. It also generated a web map in collaboration with an NGO working on the promotion of postdevelopment practices, while clarifying the proactive nature of the postdevelopment critique applied to GIS through relationality and contextual intuition. Moreover, it provided operational advice on the use of discussion and piloting in unfolding the

emergence of the unintended agency of inputs, technology and perspectives in use by the GIS user.

Finally, it suggests that the generation of contextual knowledge addressing common mapping principles arises from shared experiences within and outside of the GIS environment. This gives evidence, in turn, of the conceptual inconsistency of a strict divide between the researcher and the researched community within a perspective of critical and participatory GIS for postdevelopment.

The practical significance of the aforementioned results testify the need for an urgent critical reflection on the use of GIS in favour and in opposition to postdevelopment in practice. Specifically, while this study explored the design and challenges behind crafting a FLOSS-based participatory workflow, the actual participatory use of FLOSS instruments by non-expert and low-resource users within postdevelopment in practice is widely left unexplored.

In addition, the extensive panorama of choices and concerns that inform the workflow calls for an other relevant missing dimension of analysis: the recipient's interaction and understanding of *postdevelopment in practice*. Namely, the international literature has poorly investigated to which extent the communication of radical critiques of 'development', especially through GIS tools, could effectively inform policy making and, more generally, public decisions.

Recognising the wide unexplored nature of such debates and the pervasive agency of knowing, doing and being within a GIS environment might at times be disappointing or disorienting. Yet, it is probably by losing the way that the collective emergence of knowledge abandons the strict realm of an omnipresent and diverse 'development' discourse. Indeed, postdevelopment in practice gravitates around *already existing alternatives* scattered across the world. Rather than their simple atemporal description, the shared experience at AFSA calls for a participatory GIS practice in constant listening of relationality and of the pluriverse.

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