



UNIVERSITÀ DEGLI STUDI DI TORINO



SCUOLA DI DOTTORATO IN SCIENZE
DELLA NATURA E TECNOLOGIE INNOVATIVE

DOTTORATO IN
SCIENZE AGRARIE, FORESTALI ED AGROALIMENTARI

CICLO: XXX

**GENDER INDICATORS FOR THE SUSTAINABILITY
OF RURAL DEVELOPMENT PROGRAMMES.
CASES STUDIES IN SENEGAL AND BRAZIL.**

Francesca Alice Centrone

**Docenti guida:
Prof. Angela Calvo
Prof. Angela Mosso**

**Coordinatore del Ciclo:
Prof. Aldo Ferrero**

**ANNI
2015; 2016; 2017**

Acknowledgments

This thesis would have not been possible without the support of the DISAFA department of the Turin University.

I would like to thank my supervisors, Prof. Angela Calvo and Prof. Angela Mosso for their practical and theoretical support, contributions, and suggestions during the whole research and for their continuous efforts which allowed me to achieve these three publications. In particular Prof. Angela Calvo for her strength, passion and patience and for having introduced to my life this new field of studies.

A special thanks to Jean-Philippe Tonneau (who does not like the gratitude) for his inspiration, concrete support and for believing in me.

I would like to thank the external proof-readers (Prof. Paola Migliorini and Prof. Jean-Philippe Tonneau) and the members of the thesis commission for the time, interest and availability devoted to my work.

Thanks to Marc Piraux for having made possible the fieldwork in Brazil and to the PAPSEN and DGCS staff as well for their institutional and logistical support in Senegal.

Thanks to all the people (farmers, activists, researchers, officers, technicians) meet during the fieldworks in Senegal and Brazil (in particular Tania Leite and Nazaré and Vincenzo Ghirardi) for their precious points of views, suggestions, exchanges and complete availability. They opened to me some new incredible horizons.

Thanks to all the CIRAD and the WUR colleagues meet during my visiting periods abroad for made me feel at home.

I would like to even thank Prof. Bettina Bock for her support during my stay at the Wageningen University and for having showed me how to properly write a research paper.

Thanks to Prof. Silvia Pasqua for actively involved me in the teaching activities of her class. I really enjoyed it.

Thanks to Laura Zavattaro for her practical and sometimes redeeming help during these three years.

An enormous thank to my family (my mother, father, aunt and grandma) for standing me, support me and for letting me to follow my dreams.

A special thanks to my friends for their words of esteem, motivation and trust and for having helped me to believe in my dreams.

Finally, I would like to thank my self, for never gave up, despite the several obstacles and constraints meet during this pathway.

This work is dedicated to those who thought of climbing a 5a rock, and instead it was a 7c!

To those who believe in and work for a better and fairer world.

SUMMARY

1. INTRODUCTION.....	11
1.1 Foreword	11
1.2 Gender, development and sustainability	12
1.3 Gender indicators and development programmes in agriculture..	15
1.4 The potentiality of agroecology in promoting women empowerment and sustainability	17
1.5 The theoretical framework of the Ph.D thesis.....	18
1.6 A mixed approach for the examined cases studies	19
1.7 The methodological framework.....	20
1.7.1 Rural gender analysis in development contexts	21
1.7.2 Rapid Rural Appraisal, Participatory Rural Appraisal, Action- Research and Theory of Change	21
1.7.3 The OECD/DAC criteria.....	23
1.7.4 The Gender Analysis Framework.....	24
2. FRAMING OF THE THESIS.....	27
2.1 The sample research contexts.....	29
2.2 Methodology: adaptation of the SEAGA and of the Longwe Gender Framework.....	34
2.3 Research pathway and steps.....	36
2.4 The rural development projects in the Ph.D research.....	39
2.4.1 The PAPSEN programme	40
2.4.2 The INAE project.....	41
2.5 The scheme of the empirical material.....	42
2.6 General considerations	43
3. THE ROLE OF GENDER INDICATORS IN RURAL DEVELOPMENT PROGRAMMES.....	45
3.1 Introduction	45

3.2 Gender indicators: an overview	48
3.3 Background and context	54
3.3.1 The study area	54
3.3.2 Methodology. The gender indicator process	55
3.3.3 The Undernourishment Index (UI).....	56
3.3.4 The Adjusted Gender Inequality Index (AGII)	57
3.3.5 The GEQPAI, the GEQPRI and the GEQPUI Indices.....	58
4 Research findings.....	59
5. Discussion	66
6. Conclusions.....	68
REFERENCES.....	71
4. WATER GENDER INDICATORS IN AGRICULTURE. A STUDY OF HORTICULTURAL FARMER ORGANIZATIONS IN SENEGAL.	78
1. Introduction.....	79
1.1. Women, Access to Agricultural Resources and Drip Irrigation Systems.....	79
1.2. Farmer Organizations and Gender Exclusion Mechanisms.....	82
1.3. Water Gender Indicators.....	84
1.4. Research Questions	86
2. Materials and Methods	88
2.1. Research Context	88
2.2. Sample Description.....	91
2.3. The Water Gender Indicators.....	94
2.4. Comparison among the Three Surveyed Groups (Women, Men and Mixed)	97
3. Results	97
3.1. Indicator Values.....	98
3.2. Indicator Ratios and Comparison	100
3.3 Gender issues within the local WUAs.....	104

4. Discussion and Conclusions.....	105
REFERENCES.....	111
5. QUESTIONS DE GENRE ET DEVELOPPEMENT DURABLE: LE POTENTIEL DE L'AGROECOLOGIE DANS LE NORDESTE DU PARÁ	125
5.1 Introduction	127
5.2 Le Nordeste Paraense et la commune de Santa Luzia	131
5.3 Les représentations locales de l'agroécologie : la femme toujours vouée à l'économie domestique ?	132
5.3.1 Des représentations différentes de l'agroécologie	132
5.4 Femmes et agroécologie	134
5.5 Contraintes spécifiques liées aux femmes et à l'agroécologie ...	135
5.6 Les actions du mouvement de l'agroécologie pour lever les contraintes.	137
5.7 Impacts des actions du mouvement agroécologique pour les femmes.....	138
5.8 Discussion et recommandations.....	139
BIBLIOGRAPHIE	142
6. CONCLUSIONS	145
6.1 Main achievements around gender indicators after their application in the case studies.....	145
6.2 Agroecology, gender equality and sustainability	147
6.3 A gender sustainable framework for agroecology?	149
6.4 Conclusive remarks	151
7. REFERENCES	153

LIST OF ACRONYMS

AGII: Adjusted Gender Inequality Index
ANSD: Agence National de la Statistique et le Démographie du Sénégal
BMI: Body Mass Index
FAO: Food and Agriculture Organisation
FOs: Farmer Organisations
GAD: Gender and Development
GAF: Gender Analysis Framework
GED: Gender, Environment and Development
GEQPAI: Gender Economically Qualified Presence in Agriculture Index
GHI: Global Hunger Index
GII: Gender Inequality Index
GPII: Gender Performance Indicator for Irrigation
IBGE: Instituto Brasileiro de Geografia e Estatística
M&E: Monitoring & Evaluation
OECD: Organisation for Economic Co-operation and Development
PAPSEN: Programme d'Appui au Programme National d'Investissement de l'Agriculture
PRA: Participatory Rural Appraisal
RRA: Rapid Rural Appraisal
PRONAF: Programa Nacional de Fortalecimento da Agricultura Familiar
SDGs: Sustainable Development Goals
SEAGA: Socio-economic and Gender Analysis
ToC: Theory of Change
UNDP: United Nations Development Programme
WEAI: Women Empowerment in Agriculture Index
WED: Women, Environment and Development
WID: Women in Development
WB: World Bank
WUAs: Water User Associations

1. INTRODUCTION

1.1 Foreword

In the southern developing countries, women active in agriculture constitute an important and increasing labour force, despite often underestimated by the official statistics. Furthermore, they generally have an unequal access to and control over assets and resources (land, water, labour markets, financial services, education and technology) compared to men (Quisumbing & Pandolfelli, 2010). Such difference has direct implications in term of food security and fight against the poverty and the hunger. According to the Food and Agriculture Organisation (FAO) the number of hungry people in the world could be reduced by more than 100 million provided that women in rural areas have equal access to the same resources than men (FAO, 2011). Indeed many studies highlighted how gender equality and empowerment constitute some fundamental elements for achieving sustainable development and food sovereignty goals, especially in the agricultural sector (Meinzen-Dick et al., 2014).

In the South of the world women are especially present in the family farming, a model sometimes criticised since centred around men and based on the traditional division of agriculture labour (Prevost et al., 2014; Kerr, 2008). This traditional division of agricultural labour sees generally women entitled to the more complementary and less economically valuable tasks (i.e. horticulture, harvesting and manual removal of weeds). However, such tasks are often the most beneficial from a nutritional point of view (both for children and the whole household) as well as the most attentive towards the biodiversity protection (Kerr, 2008, *ibid.*).

For these reasons women farmers are often present in agro-ecology, based on a strong recognition of knowledge, skills and experiences held by the local small farmers, which is proposed as best practice for

achieving a sustainable development (Altieri, 2002; Altieri & Toledo, 2011; FAO, 2011; Tonneau & Teixeira, 2002).

However, some studies (Nobre 2005; Peterman et al., 2014) stated that the women's great preference for more sustainable farming practices was not only conditioned by ecological choices, but rather by mechanisms of exclusion from technology, extension services and technical assistance, among others. An exclusion partially caused also by the advent of the "Green Revolution" in agriculture (Mies & Shiva, 1993; Shiva, 2016).

In this framework the labour division and the gender issues in agriculture play a crucial role to realize a sustainable development. As stated by UN WOMEN: "Sustainable development is economic, social and environmental development that ensures human well-being and dignity, ecological integrity, gender equality and social justice, now and in the future" (UN WOMEN, 2014, p. 26). The process to guarantee an objective gender approach within the agricultural programmes, aimed to achieve a sustainable development, started about fifty years ago and it is still on-going.

1.2 Gender, development and sustainability

The United Nations' Decade for Women (1976–85) was crucial in highlighting the importance of the contribution of women (often previously invisible) in the social and economic contexts, also in agriculture. Researchers and policymakers started to switch their analyses and interventions from the reproductive role of women within the family to their productive and employment position (Moser, 2003). The publication in 1970 of the book "Woman's Role in Economic Development" by Ester Boserup inaugurated a new pathway towards the studies of women in development. Boserup stated how new technologies and innovations introduced in the developing countries were targeted on men and how women were excluded from the whole

process of development, losing traditional sources of power (Brown, 2007). The concept 'Women in Development' (WID) originated by the Boserup work was subsequently adopted by the United States Agency for International Development (USAID) and became the so-called Women in Development (WID).

However, recognizing the limitations of focusing only on women as "isolated" subjects, in the following years a different 'Gender and Development' (GAD) approach was introduced (Oakley, 1972; Rubin, 1975). The WID perspective was based on the rationale that development processes would have been successful if women were included into them, while the GAD gave a greater emphasis to the gender relations (Moser, 2003). According to Cornwall (2003) the WID approach intended to give to women a place within the existing system, without directly transforming the actual gender inequities, as happened for the GAD who considered women as "makers and shapers" of the development processes.

In these years the United Nations organized four world conferences on women: Mexico City (1975), Copenhagen (1980), Nairobi (1985) and Beijing (1995). During the Beijing conference 189 countries adopted the Beijing Declaration and the Platform for Action, a series of key points to address the international agenda on women's empowerment and gender equality (UN Women, 2017).

Hereafter the expressions "gender equality" and "women's empowerment" were spread and diffusely used as ways to advocate the women rights and conditions in front of the international development agenda (Cornwall & Rivas, 2015). In particular women's empowerment represented an evolving process, in relation with the concept of "agency" who sees women as the real protagonists of their change (Ibid.). Empowerment comprises not only actions and policies, but also values and motivations behind the actions of individuals (Kabeer, 2005).

The question is: how to evaluate and measure women's empowerment?

According to Moser (2007) women's empowerment cannot be actually described by a unique indicator and should be measured through many dimensions, also qualitative, to better identify the whole specific context behind. Kabeer proposed three inter-related dimensions: access to resources (the preconditions for empowerment), agency (the process, the ability to define the goals and act upon them) and achievements (the outcomes) (Kabeer, 1999, 2001).

In the same years the gender mainstreaming concept was introduced. According to Moser (2007, p.17) gender mainstreaming is an organisational strategy aimed to "bring a gender perspective to all aspects of an institution's policy, programme and project processes". Words as gender equality, women empowerment and gender mainstreaming are part of the international agenda glossary. However, the necessity to actual implement, monitor and evaluate such goals in the concrete interventions is largely debated (Cornwall & Rivas, 2015; Cornwall & Anyidoho, 2010; Moser & Moser, 2005).

Within the debate around the role of women in promoting more ecological and sustainable practices, the WED (Women and Environment) and the GED approaches (Gender, Environment and Development) can be identified. The WED points out that women are, "by virtue of their biological relationship to reproduction, more closely connected to nature and thus both more likely to be harmed by its degradation and more likely responsible" (Meinzen-Dick et al., 2014, p. 30). The GED focuses more on the nature of the gender knowledge (Moser, 2003), giving a greater consideration to the issues related to the access and control over resources and to the engagement between local struggles and global instances (Leach, 2007). Besides the GED envisages a more heterogeneous point of view towards women, incorporating other elements to the analysis of women's role in natural resources and environment, as age, class and ethnicity (Mikkelsen, 2005).

The connection between gender and sustainability can be analysed according to two different sides: the potential contribution of gender equality towards sustainability and vice versa the impact of sustainability (and sustainable practices) on gender relations (Meinzen-Dick et al., 2014). Sustainability is a broad concept first appeared in the Brundtland Report of 1987 made by the UN World Commission on Environment and Development (WCED), which defined sustainability as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p.37). It includes three main dimensions: social, economic and environmental, which are interdependent and mutually reinforcing. Despite the importance dedicated to the environmental concerns, the main argument below such concept is the inter-generational equity (Kuhlman & Farrington, 2010). Sustainable development is a central goal within national and international institutions, corporate enterprises, and local stakeholders (Kates, et al., 2005). Together with the will to achieve greater sustainable development comes the question of how to measure and assess its practical implementation and effects.

In order to answer to such needs, theorists work on a huge and continuous proliferation of indicators (Ibid.).

1.3 Gender indicators and development programmes in agriculture

In these last years it can be observed an increasing need and demand for monitoring (M) and evaluation (E) tools to measure the impact of agricultural development programmes (and indirectly of their relevant policies), in particular in terms of sustainability and gender equality (Kabeer, 2005). The choice about what and whom to measure constitutes both a technical and a political choice (Davis, 2012) and can be translated into the use of gender sensitive indicators.

Gender-sensitive indicator “refers to a number, opinion or perception that indicates whether or not policies, activities, resource inputs, and other services are delivered equitably to men and women in a timely and efficient manner” (UNESCO, 2015, p.11).

Gender-sensitive indicators present some positive aspects:

1. they provide gender-disaggregated data (highlighting the differences between women and men);
2. they allow to jointly collect qualitative information to assess and relate gender attitudes and behaviours to socio-cultural values;
3. they show changes of the relations between women and men over the time;
4. they may contribute to assess empowerment changes over time and to subsequently to readapt the actions for the future;
5. they are internationally comparable (Permanyer, 2010).

Nonetheless, gender indicators also entails some negative constraints:

1. they deal with several difficulties to actually define and assess empowerment and they may influenced by the personal perceptions of the researchers (see Kabeer 1999, 2005);
2. they generally require a huge availability of gender disaggregated data, not always easy attainable and available (especially at rural level and in developing countries see Moser, 2007; Doss 2014);
3. they may become some quite complex tools (Beneria & Permanyer, 2010) to be calculated and thus understood, owned and effectively used by the target beneficiaries (Molle & Mollinga, 2003).

Process gender indicators, instead, measure the delivery activities of the resources devoted to a program or project (Moser, 2005; Moser 2007). Moser (2007) identified two different types of indicators: indicators that assess the implementation of procedures and indicators that measure the effects of interventions on women in developing countries.

Since analysing gender is a complex issue implying several dimensions and because of the mentioned obstacles to merge together the different

aspects behind the women empowerment, the main gender indicators elaborated until now have been multidimensional (see Chapter 2).

Nonetheless, despite the wide range of gender indicators elaborated and largely discussed (Dijkstra, 2006; Klasen & Schüler 2011), they are not specifically designed to agriculture and to agroecology (with the exception of the Women Empowerment in Agriculture Index, see Alkire et al., 2013).

1.4 The potentiality of agroecology in promoting women empowerment and sustainability

The word agroecology may be used according to three differing interpretations: scientific discipline, social movement and practice. Many studies associated agroecology with food sovereignty and sustainable development (Wezel & Soldat, 2009; Altieri, 2009). Within the agroecosystems science, the connections between nature-conservation and agricultural sustainability became increasingly important, focusing on the strong relationships between local traditional knowledge and the landscape to achieve sustainable outcomes (Wezel & Jauneau, 2011).

Agroecology diminishes dependence on external inputs, and thus on subsidies and loans, commercial fertilizers, and pesticides. Diversified farming systems produce their own fertilizers and pest control, diminishing the need of pesticides (Altieri & Toledo, 2011). According to Addinsall et al. (2015) the availability of locally- adapted seeds, planting materials and livestock breeds also has multiple advantages for farmers, even providing diverse crops (as maize, rice, millet, sorghum, etc.). Agroecology, eliminating the credits need to buy synthetic inputs, can be particularly beneficial for small farmers (first women) who have low or no access to credit, capital, or who cannot afford commercial fertilizers (De Schutter, 2011; Lappé, 2016). Some studies (Reij et al., 2009; Dalle et al., 2014) showed that agroecology may contribute to reduce the gender gap allowing women to achieve better economic and social position.

Some practical best practices were offered by the Farmer Managed Natural Regeneration across the Sahel region (with a significant impact on the availability of fuel, wood, water, and increased income for the local women) and the community seed banks focusing on local food systems and women as food producers (*ibid.*).

1.5 The theoretical framework of the Ph.D thesis

The main goal of the Ph.D research was aimed to answer to the following question: are gender indicators some appropriate and effective tools to both promote a greater success and sustainability of agricultural development programmes (including those inspired by the agro-ecological model) as well as to measure, assess and identify the main factors influencing sustainability?

The initial hypotheses were as follows:

- a) under certain conditions the rural gender analysis allows to evaluate rural development projects, promoting a greater gender equality and subsequently a better sustainability;
- b) some existing more general gender indicators adapted at local level allow to partially deal with some of the main indicators constraints;
- c) the application of suitable gender indicators to agroecological projects may be an interesting and valuable experiment.

Thus, three main research phases have been carried out in order to test and verify each of the mentioned hypotheses.

In particular we can identify the following three research cycles.

2015-2016: cycle 1 and 2. These two preliminary phases allowed to test the initial hypotheses and to better delineate the analysis of gender issues over the time. Such two steps were carried out in Senegal within an international rural development and food security programme, the PAPSEN programme (see below for more details).

2016-2017: cycle 3. This last phase represented the final completion and integration of the previous studies. In particular this third phase was

realized in Brazil within an agroecological research project, the IDAE project (see below for more details).

The final expected outcomes of this methodological thesis were to contribute to assess and evaluate the impact of gender equality/inequality in terms of sustainable development through the study and the application of some gender indicators within some “conventional” and agroecological experiences.

With regards to the research rationale towards gender and development issues, we stated four main considerations:

1. gender is a complex issue and indicators have a double attitude towards complexity: on one side they would reduce the complexity through the use of suitable modelling, but at the same time they can tend to become too much complex;
2. gender mainstreaming needs to be operationalized in the field;
- 3 gender indicators may be a tool which help to do it;
4. nonetheless, gender indicators have limits. Such as the discrepancies between the design phase and the implementation, a gap implying a strong methodological effort, as visible through this research.

For these reasons, a mixed approach for the case studies was necessary.

1.6 A mixed approach for the examined cases studies

Quantitative research is used to quantify the studied issue producing numerical data or statistics. It is applied to quantify attitudes, opinions, behaviours, and other variables in order to generalize the results starting from larger samples of respondents. Quantitative data collection methods, more structured than qualitative methods, generally include tools as: paper surveys, online surveys, face-to-face interviews, systematic observations etc. On the other hand, qualitative research is generally used to picture opinions and motivations of respondents, providing insights around a specific issue. The sample size is typically

smaller, and respondents are selected in order to achieve a representative sample. Qualitative methods include: focus groups, individual interviews and participant observations. Finally, participatory research is based on the concept that the same respondents should be the agents of their own development, contributing to the assessment process even about what should be measured and through which types of indicators, and directly participating in the whole research phases (Mela 2017; Bergold & Thomas, 2012).

Mixed methods are very often presented (Small, 2011) as the best choice for the monitoring & evaluation of international development programmes, including gender issues. Indeed, despite some well recognized difficulties connected with the implementation of such mixed methods (e.g. additional costs, time and logistical challenges, security issues, etc.), particularly when working in remote rural areas, these methods present some evident opportunities (Bamberger et al., 2010). Indeed, they allow to achieve: a more rapid and low cost data gathering process, many sources of quantitative and qualitative information, more reliable baseline data, and a greater scope of the project efficacy assessment (ibid.).

Generally gender analysis uses both quantitative and qualitative methods to examine gender roles and norms, in order to better understand how women and men interact with and within different systems and programmes (Quisumbing & McClafferty, 2006).

During the research (according to the objectives, the timing, and the resources constrains) we decided to apply a mix of quantitative, qualitative and participatory methods, with a lesser use of these latter.

1.7 The methodological framework

This section explains and discusses the main methods (and frameworks) proposed by academics and practitioners to study and assess the

effects of rural development interventions, with a special focus on gender issues.

1.7.1 Rural gender analysis in development contexts

Gender analysis examines how the social roles, resources, needs, constraints, and opportunities of men and women are determined and how those roles affect the relating outcomes for an effective research planning and implementation (Parpart et al., 2000). According to Doss (2014, p. 6) “In agriculture, gender analysis provides insights into how socially constructed roles and responsibilities shape the myriad decisions around agricultural production and processing”. These considerations lead to exploring even the processes of generation, sharing and use of knowledge between women and men (ibid.).

At the beginning of the XXI century, a report of the Finland Ministry of Foreign Affairs (Vainio-Mattila, 2001) proposed the following five gender analysis steps (even applicable at rural level):

- a) identify purposes;
- b) identify key persons/subjects;
- c) choose/build the framework;
- d) use the framework;
- e) use the information (in order to put into action, change the reality and favour the decision-making process).

In relation to this list, during the third phase of the Ph.D research (in Brazil) we followed the first three stages. After identifying the specific goals of our analysis, we selected the key informants and we have started to elaborate our own framework. Then, we started to apply the drafted framework to the agroecology experiences in Brazil.

1.7.2 Rapid Rural Appraisal, Participatory Rural Appraisal, Action-Research and Theory of Change

At the end of the '70s, the increasing awareness of the failures of conventional methods to gather social information on rural development

projects conducted the proposal of alternative approaches and methods. One of these was the Rapid Rural Appraisal (RRA), developed since the late '70s/beginning of '80s. The RRA can be defined as "a semi-structured activity carried out in the field by a multidisciplinary team and designed to acquire quickly new information on, and new hypotheses about, rural life" (Barrow, 1999, p. 111). The RRA presented the growing recognition that rural people are themselves knowledgeable about many subjects of their lives (Chambers, 1994). The RRA largely advocates for the importance of involving outsider researcher, as the Ph.D candidate in this case.

During the decades '80-'90s a new concept was introduced to stress the active role of the surveyed people: the Participatory Rural Appraisal (PRA). The PRA can be defined as an "approach and methods for learning about rural life and conditions from, with and by rural people" and includes inside various evolving approaches, as the activist participatory research, the agro ecosystems analysis, the applied anthropology, the field research on farming systems (Chambers, 1992, p.5). The PRA added new attention to facilitate the analysis and investigation process, to the importance of the self-critical, and to the necessity to share the collected knowledge with the rural people (Chambers, 1992). The PRA stresses how the whole process should be developed on going and by the same local community (in a way very closed to the concepts typical of the agroecological approach). In this Ph.D research we can see both these approaches, a mix frequently promoted by academics and practitioners (FAO, 2001).

The Action-Research can be seen as a methodology fostering the possibility and the usefulness of directly involving research partners and practitioners in the process of knowledge production and sharing (Bergold & Thomas, 2012; Bradbury-Huang, 2010).

The Theory of Change (ToC) contributes to better assess interventions goals, implementation and effects, connecting activities with desired

outcomes and impacts (Connell, & Kubisch, 1998). ToC may be defined as a reflexive process to “explore changes in a particular context and with a particular group of people” (Hay, 2012, p. 5).

Krishnan (2017) suggested the following steps to develop a ToC:

1. Conduct situation/context analysis;
2. Clarify the programme goal;
3. Design the programme/product;
4. Map the causal pathway;
5. Design SMART (Smart, Measurable, Achievable, Relevant, Time bound) indicators;
6. Explicate assumptions;
- 7 Elaborate the logical framework.

Even within the ToC the importance of elaborating suitable indicators as well as the trade-offs between quality/cost and validity (accuracy) /reliability (precision) of collected data is largely highlighted (ibid.).

1.7.3 The OECD/DAC criteria

Other important criteria widely applied and still valuable in development evaluations are those jointly proposed in the ‘90s by the UNEG (United Nations Evaluation Group) and the OECD/DAC (Organisation for Economic Cooperation and Development’s Development Assistance Committee) (OECD, 1991). These criteria were:

1. Relevance (the extent to which the intervention is appropriated to the priorities of the target).
2. Effectiveness (a measure of the extent to which an intervention achieves its objectives).
3. Efficiency (measuring the outputs in relation to the inputs, it shows if the selected programme uses the least costly resources possible in order to achieve the desired results).
4. Impact (the positive and negative changes made by the intervention, that may be directly, indirectly, intended or unintended).

5. Sustainability (to assess whether the benefits of an activity are likely to continue after the end of the intervention).

The UNEG also suggested the integration of human rights and gender equality values within the DAC criteria (UNEG, 2011).

Nonetheless their huge application and coverage, even the OECD/DAC criteria may be subject to some criticisms, such as those suggested by the Brazilian researcher Chianca (2008, p. 45):

1. the relevance currently focuses first on the goals of donors and policy makers, instead of focusing on the needs of the target;

2. the concept of effectiveness focuses on determining the extent to which the intervention met its objectives, and not the beneficiaries needs;

3. the definition of sustainability appears limited to sustainability as future prospective without considering the past sustainability. Furthermore the excessive weight attributed to environmental and financial aspects of sustainability, without adequately considering other important features as political and institutional framework, cultural, and technological adequacy;

4. efficiency is too much focused on the costs side;

5. there are two missing supplementary criteria: the quality of the process (e.g. ethicality, environmental responsibility) and the potential exportability of the intervention in other contexts.

1.7.4 The Gender Analysis Framework

Kabeer (1994) stressed the different ways in which gender might be present or absent in the evaluation process (gender-blind; gender-instrumental; gender-specific; gender-transformative). Thus, since the '90s an increasing demand for more effective and efficient gender sensitive methods (Longwe, 1995; Rao, 1991; Gianotten et al., 1994; Karl, 1995) can be observed in order to gather data, inform policy makers and prevent possible negative effects of such actions.

Gender analysis frameworks jointly evolved with the changes occurred over the time in relation to the concept and interpretations of gender (Warren, 2007). The gender analysis framework (GAF) is a tool used to organise the information, to examine the differences between gender roles, needs, etc., the levels of power relations, and the impact of these differences on women and men. One of the main challenges related to the elaboration and proposal of new gender frameworks (one of the main future expected outcome of this Ph.D research) is the necessity to avoid fads and to effectively apply the gender analysis in order to actually use the gathered information, and change and improve the impacts and the sustainability of development interventions.

The most commonly used and well known GAFs are: the Harvard Analytical Framework (ILO, 1998), the Moser Gender Planning Framework (Moser, 1995), the Socioeconomic and Gender Analysis Programme (SEAGA) of the Food and Agriculture Organisation of the United Nations (FAO, 2001), the Gender Analysis Matrix (Parker, 1993), the Women Empowerment Framework (Longwe, 1995; 2002), the Social Relations Framework (Kabeer, 1995; Kabeer & Subrahmanian, 1996). The more recent Complementing Gender Analysis (CGA) incorporates the concept and role of social capital and equity, considering men and women in complementing roles that may lead to gender equality (Kumar, 2016).

The use of more or less famous gender frameworks is almost spread by researchers and international institutions. Nevertheless, according to March et al. (1999), we must be careful to apply gender frameworks in an exclusive ways because other gender-sensitive techniques should be implemented. Moreover, the GAFs may be influenced by personal perceptions and they are not the only methods suitable to accomplish a greater gender equality within development programmes (*ibid.*).

Another important issue is the ability “to listen to, consult with, and learn from the communities about” (Warren, 2007, p. 194), also involving both

women and men in the planning and evaluation phases of such development programmes. Finally, the elaboration of hybrid models, joining different elements of the previous methods according to the specific research contexts, needs, goals, time and space constraints, and available resources is a potential way to more accurately designed GAFs (ibid.).

This large methodological overviews allows to understand how the conceptualisation of gender and rural development issues and methods evolved over the time. Starting with the huge attention dedicated to the study of gender relations (see the proliferation of gender frameworks and indicators) during the '90s, even in the wake of the 1995 Beijing conference, and going towards the most recent attempts (as the Theory of Change). At the same time, another aspect emerges: the general feeling that in this last decade we are assisting to a new renovated push towards gender issues. However, despite the large improvements towards gender equality worldwide, first in relation to the educational rights, the increasing violence against women shows that the pathway is still long.

2. FRAMING OF THE THESIS

The Ph.D research is included within a broad and general debate around gender issues, sustainability, and the necessity to measure and assess the progresses made by the development programmes, as previously described.

On the basis of this complex debate, this research aims to study and test whether (and which) gender indicators may be appropriate and effective tools to measure the main factors influencing the gender equality, the success, and the sustainability of agricultural development programs, even those inspired by the agro-ecological model. To achieve these goals, the Ph.D research first studied the possible application of international gender indicators at local level, secondly it applied a system of gender indicators at farmer organizations level and with a specific focus on water issues (a resource entailing many implications in terms of gender issues) and finally it focused the analysis to an agroecology project, since this alternative model it is generally presented as more open and careful towards fair social relations, as those between women and men.

Basically the Ph.D research accomplished the following methodological steps.

Step 1: bibliographical review on rural development and gender issues, empowerment, methodologies for sustainability and gender assessment (end 2014/beginning 2015).

Step 2: baseline assessment and characterisation of the first case study in Senegal, in terms of gender issues in agriculture and definition of the main analytical dimensions (techno-productive, socioeconomic and political-institutional information) (2015).

Step 3: application of a gender analysis to the documents and the M&E questionnaires of the selected project. Design and test of semi-

structured interviews to gather the information required for the indicators (2015).

Step 4: first phase of fieldwork (2015) in Senegal where we carried out semi structured interviews and public presentations with local key informants and we made a policy and literature review of gender statistics in agriculture.

Step 5: statistical analysis of the collected data, elaboration of three gender indicators, proposal and joint discussion of such indicators with a selection of the main local stakeholders (2015-2016).

Step 6: improvement of the methodological framework thanks to exchange and discussion sessions with gender and rural development experts, redaction of the chapter book around this previous research cycle (2016).

Step 7: on the basis of data coming from the questionnaires of the sample Senegalese project, proposal and elaboration of a system of indicators focused on water, gender issues and farmer organisations (2016).

Step 8: discussion and adjustment of the basic dimensions and indicators according to the information gathered through the previous phases (2016).

Step 9: new bibliographical review more focused on gender and agroecology issues both in Senegal and Brazil (2016-2017).

Step 10: redaction of a paper on water gender indicators and farmer organizations in Senegal (2016-2017).

Step 11: fieldwork in Brazil (2017) where we applied a more participatory and action research approach, realizing semi structured interviews and focus groups in order to improve the quality of the previous surveys in Senegal and to compare the results with different research contexts.

Step 12: synthesis and integration of the main outcomes and results.

Step 13: redaction of a paper on gender and agroecology issues in Brazil and thesis drafting (2017-2018).

The thesis results from the combination of participant observation, interviews, systematic review processes and exploitation of written and oral sources (De Sardan, 1995). In the Ph.D research, this combination was multi-sequential (in different times and places), longitudinal (including short life histories) and also polyphonic (through points of view expressed by different actors on the same object) (ibid.).

The applied methodology included preliminary data collection (with primary and secondary sources), then the design and the calculation of some original gender indicators and the initial application of an original gender framework to agroecology.

2.1 The sample research contexts

The selected geographical contexts (Senegal and the Brazilian state of Pará, Figure 1 and 2) presented some differences in terms of agricultural, environmental, economic and socio-cultural aspects.

Figure 1 Senegal map (source: Senegalese National Statistical Agency)



Figure 2 Pará map (Source: Encyclopedia Britannica)



The first difference is the geographical surface and the population density. Pará is the most populous state of the northern region, with a population of over 8.4 million. It is the second-largest state of Brazil covering an area of 1,247,689.5 km² (*Governo do Estado do Pará*, 2018) almost ten times than Senegal (196,712 km², ANSD, 2018). Despite its large extension, this Brazilian state has a very slow population density (6.2 inhabitants/km², IBGE, 2009), mostly because of the huge presence of the Amazonian forests, while Senegal recorded 80 inhabitants/km² (ANSD, *ibid.*). Furthermore, the average dimensions of the cultivated plots largely differed between the two countries. In 2015 in the Senegalese *Bassin Arachidier* the 75% of farms were smallholders. The agricultural surface mostly ranged between 1 and 5 hectares (Sall, 2015). Instead in Brazil the family farms, ranging between 10 and 50 hectares, were around the 30% of the total, while smaller farms ranged between 2 and 10 hectares (IBGE, 2009).

The second difference are the local natural resources. Conversely to Senegal, the Amazonian state of Pará does not suffer from a huge and critical depletion of natural and environmental resources. Indeed, this Brazilian country can count on a really deep biodiversity and fast renovation of natural resources. However, the effects of the natural resources management and relating policies are strongly criticized and debated.

Senegal and Brazil have also different economic performance levels. Brazil is considered a strong emergent economy (it is included between the NICs: Newly Industrialized Countries) and a model of “good” development worldwide, despite its various internal critical problems (current political instability, increasing in social inequality, ambiguous attitude towards the environmental protection). Senegal is instead a smaller country with a quite political stability.

The two countries give also different importance to the family farming system (despite both the countries applied a dual rural development policy promoting both family farming and agribusiness models).

In Brazil family farming was not a dominant agricultural model. Since the Portuguese colonisation in the XVI century, the family farming model was used by the land owners to favourite the installation of big farms. Such installation was realized through different systems according with the different crops (i.e. cotton, sugar cane, cocoa, coffee) but with similar effects to the small farmers, entitled to the less qualified tasks as cleaning etc.. Thus they had lower access to land for their self consumption needs and they were obliged to progressively move towards the most isolated and difficult to cultivate lands, as the internal forests, requiring hard deforestation operations (Tonneau, 1994; Tonneau & Sabourin, 2009).

On the other side, in Senegal a “trade” model was applied since the beginning of the XX century, which forced the small farmers to change their production systems introducing the peanuts plantations, but without predicting the creation of big farms (Pélissier, 1966). The dual presence of family farming and agribusiness is here a quite recent fact (since the ‘80s) and the 95% of the available land is cultivated by small farmers. Indeed, the first national programmes directly designed for small farmers started in the ‘60s (Ndiaye, 2013), while in Brazil later, during the ‘80-’90 decade.

The actors investing in rural development and family farming programmes are also different in Senegal and in Brazil. In Senegal the role of international development donors is still predominant, while in Brazil the main agricultural and family farming promotion programmes are funded by the federal government since early 2000. Such differences entail important open issues in terms of programmes sustainability and women empowerment.

However, some similarities emerged between these two countries.

Both the selected areas are highly environmentally vulnerable. Senegal is a Sahelian country subject to several dryness's and erosion problems. Conversely, the Brazilian state of Pará is included within the Amazonia, where the climatic and environmental equilibriums are particularly threaten. In this geographical zone the main problems concern: the soil erosions (due to the excessive precipitations levels, conversely to Senegal who lived a progressive strong reduction of the raining seasons during the last decades); the increasing space intended to commercial and and/or transgenic crops (sugar cane, soybean) plantations; the cattle ranching, detrimental for forests and fertile lands; the waste management issues, especially in rural areas.

The two contexts (even in different ways) are progressively becoming attractive to foreign and international agricultural investments. Such international interests make controversial perspectives in terms of national policies suitable for the promotion of the local family farming systems, the sustainable development, and the women empowerment. In particular in Africa some studies (Fitzpatrick, 2015; Kachika 2011) showed how the effects of the so-called land grabbing resulted often worst for women farmers then men. According to the FAO (2013), agribusiness agriculture tends to discriminate women, preferring to employ men, while women are generally involved in the most unsecure, bad paid and unqualified jobs. And again other analyses found how women were often excluded by contract farming because of their lack of statutory rights over land (DFID, 2014).

Moreover, both the sample areas suffer from an increasing rural exodus of the rural population (first young people) leaving the countryside for the cities (in the Pará state around the 40% of the population) entailing dramatic consequences in terms of urbanisation rates.

According to the latest surveys, in Senegal the employment rate in agriculture was 33.7%, whose 33.0% was female (FAOSTAT, 2018a);

while in 2014 in Brazil it was drastically less, rather 15.3%, whose 11.0% female (FAOSTAT, 2018b).

The family farming models (implemented within both the countries) tend to be strongly influenced by the traditional division of agricultural labour and by an overall more or less hidden discriminatory attitude towards women farmers.

In particular in both the research countries local women suffered from a common core of constraints:

- very partial acknowledgement of the effective role of women in the local agriculture. This bias is perpetuated by men and institutions as well as by the same women farmers who sometimes are not used to recognize, measure and assess their effective economic contribution to the household, farm and community;
- limited access to the tangible inputs, first technology, credits and land;
- difficult access to higher education levels which limits the women's active presence and decision power within local and national institutions (as farmer organisations and legislative bodies). Nonetheless, in Senegal we can observe an increasing presence of women in leading positions of civil societies organizations and technical-political commissions. In Brazil, instead, the current political instability seems to entail a general arrest of the reforms process including more inclusive and gender oriented policies and programmes, inaugurated during the previous governments (see below);
- unfair access to technical assistance and extension services which limits the spread of knowledge and the access to credits and supporting agricultural programmes for women. Simultaneously, most of the technical officers belonging to such institutions are men;
- a quite invisibility of the role of women in agriculture due to the lack of gender disaggregated data (especially those regarding the more productive-oriented aspects) and of specific national statistical surveys

intended to measure and valuing the contribution of the women farmers. About this last constraint, we can notice how generally in Brazil, thanks to the policies carried out by the previous governments of the Labourers Party (of Luiz Inácio Lula da Silva and Dilma Rouseff), an higher attention was dedicate to promote and implement specific supporting measures for women farmers (as the *Linea Mulher* of the National Programme for Family Farming, PRONAF).

On the other hand, the conditions of women farmers in these two contexts presented even some positive common points, in particular in terms of contribution to sustainable development and general empowerment. In both the countries women are in charge of the traditional knowledge about the collect, use and cultivation of local plants and crops suitable for nutrition and medical purposes, as well as the application of most sustainable agronomic and ecologic practices. Nonetheless, the economic value associated to such type of tasks is often low and they are considered as secondary and complementary elements to the agricultural activities carried out by men. In both the countries, the strong connection between the importance of the recognition of women in agriculture, the greater empowerment generated by the fact to belong to some intermediate organisations (as the Senegalese FOs or the female networks in Brazil), and the general impact in terms of general empowerment represent possible ways to increase the women' autonomy, self-determination and fight against the domestic violence.

2.2 Methodology: adaptation of the SEAGA and of the Longwe Gender Framework

The methodology used in the Ph.D research has been mixed and multiple. The starting point was aimed to partially join the gender analysis issues with some of the methods described in chapter 1.

The gender frameworks which seemed the most appropriate and coherent with the Ph.D research goals were the SEAGA model and the Longwe Gender Framework.

The SEAGA approach is based on an analysis of socio-economic patterns and participatory identification of women's and men's priorities. In particular it is focused on three main pillars (socio-economic analysis, gender analysis and participation). In the design of our methodological framework we partially applied these three pillars, adapting them to our specific research goals and practical constraints (i.e. the research was not focused only on one project, it was not realized in a single country, and the available human and financial resources were not suitable to apply the whole methodology proposed by SEAGA).

The SEAGA model (FAO, 2001) proposes three levels of analysis: macro, intermediate and field. The macro level focuses on policies and plans, both national, international and socioeconomic. The intermediate focuses on structures, such as institutions and services aimed to better connect the macro and the field levels and includes extension services and farmer organisations. The micro focuses on people, including women and men as individuals, and communities.

In particular the first Ph.D research cycle (2015) included a more policy and programme-management oriented gender analysis at macro level. The second research cycle (2016) was more focused on gender and access to a specific resource (as water for production purposes) at the farmers organisations (FOs) level. The survey carried out during the third cycle (2017) strictly focused to the individuals perceptions (about rural development, sustainability and gender equality) expressed by very different typologies of key informants (micro level). As in the SEAGA model, even during the Ph.D research we used different types of written (projects documents and reports, socio-economic and statistical surveys) and oral (focus groups, life story interview, semi-structured interview, public joint presentations and debates) sources.

The choice to partially use as reference the concepts developed by the African researcher S. H. Longwe (2002) was instead influenced by the following reasons:

- a) the Longwe framework affirms that the women's empowerment enables women to have an equal position in relation to men, and to equally participate in the development process;
- b) the framework aim is mainly assessing to what extent a development intervention actually supports women empowerment.
- c) the Longwe framework practically applies and compares each other two different women empowerment tools (five different levels of equality - control, participation, conscientisation, access, welfare - and three levels of gender aspects recognition within the project objectives - negative, neutral, positive).

If on one hand the SEAGA tool was more useful in term of practical application in the field of the rural gender research, the Longwe framework represented a support instrument helping to organize the most policy-oriented gender analysis of the selected projects and programmes documents.

2.3 Research pathway and steps

One of the main goal of the research was to test (and consequently enhance) the quality and the effectiveness of the gender indicators proposed at international level. To achieve this objective we passed through several attempts.

We first reflected on the potentially to change the geographical scale, switching from international to regional indicators (step 1).

Then we applied a suitable system of indicators to a specific topic (i.e. water access and use within a conventional horticulture development project) (step 2).

Finally, we carried out a gender analysis focus on agroecology at individual level, aimed to finally achieve a specific gender framework (including original indicators) (step 3).

In particular we passed from a purely quantitative approach (research steps 1 and 2) to a mixed approach, both quantitative and qualitative (step 3). The choice to apply this double method was influenced by the will to make more closer the elaborated gender indicators (and the whole framework) to some sample key informants, in order to give a suitable space to their personal perceptions and scales of values. This double approach was intended to favourite a process of re-appropriation (particularly of the potential of data and indicators) and co-design of such tools, aimed also to dedicate more space to the specific needs and characteristics of the involved people.

The research steps should be interpreted as an on-going, testing and increasingly complex process. The final desired outcome of the whole process is starting to propose an innovative gender framework for agricultural development programmes, notably agroecological.

In particular, in the first Senegalese example, we did not provide a diffused discussion about the choice of the criteria behind the choice of indicators, focusing on the direct application of them from international and national to the regional and local scales.

In the second Senegalese study we tried to fill the previous gaps and to make the applied indicators more comprehensive.

In the last Brazilian case we made a gender analysis discussing and validating the indicators in field. In order to achieve this goal, we tried to apply the method of evaluative questions, using the projects objectives (in this case agroecological goals) as milestones (on the basis of the Longwe gender framework). We started the theoretical analysis with three main evaluative questions each of them implying two different phases: labelling (aimed to a better in depth analysis) and implementation (to verify the evaluative questions in the field).

1. *Are gender issues included and considered by the (rural development/agroecological) project ? (YES/NOT)*

1.1 How we can define, identify and address what is gender or not?

1.1.1 through the adoption of a gender analysis and ad hoc indicators (labelling phase)

1.1.2 through the application of the gender indicators framework (implementation phase)

2. *Does the (rural development/agroecological) project have positive effects (improved/changed/affected) in terms of gender equality/women empowerment? (YES/NOT)*

2.1 definition of the criteria to define women and men roles, access to resources, and general empowerment. Specifically, our empowerment criteria considered women as more competent, more independent, and more efficient. Therefore, more empowered (labelling phase)

2.2 application of the indicators (implementation phase)

3. *Does the (rural development/agroecological) project contribute to sustainable development? (YES/NOT)*

3.1 How we can define, identify and address what is sustainable development or not, according to our goals?

3.1.1 Set of sustainable development indicators (labelling phase)

3.1.2. Application of the indicators (implementation phase)

Then we proceeded with the final cross reading phase, which resulted from the matching of the outcomes coming from the three previous steps.

About the third research phase (agroecology project in Brazil), following the multiple approaches advocated by Action Research, the empirical methodology was as follows:

a) review of secondary data (through documentary and quantitative analysis) aimed to understand how gender is implemented in the M&E process;

b) direct observation;

c) individual and key informants semi-structured interviews and discussion groups (more qualitative oriented) aimed to collect and rank the local and personal gender indicators (and also to test and evaluate the potentiality of other proposed external gender indicators);

d) participatory and practical sessions in order to make a triangulation with the previous phases, data and results, such as the ranking matrix.

The ranking matrix is a typical tool of the RRA and of the SEAGA, explicitly gender oriented. The stakeholders' more important criteria to be measured and assessed through the use of a pairwise ranking matrix (and thus after potentially translated into indicators) were related to the meanings and synonyms of the concepts of women empowerment, gender equality, sustainability and agroecology. We asked first to the interviews to rank the values associated with the word agroecology (i.e. social movement, agronomic practice, methodology, etc.) following a decreasing order, from the most important to the least.

Then the initial intend was to compare the results coming from this participatory research moments with data extrapolated by the monitoring/evaluation sessions carried out by the project implementers. The main constraint was the current phase of the sample project characterised by an initial internal research work aimed to the elaboration of M&E tools, but which is still on-going. For this reason it was not possible to conduct a complete comparative analysis.

2.4 The rural development projects in the Ph.D research

The Ph.D research was carried out in the framework of two different projects. The first was an international rural development programme, with a quite high agronomic and technological orientation. The second was an international research programme, characterized by a more policy-making and socio-economic interest towards agroecological experiences. These two case studies well represented different types of approaches and actors working in the space of development studies as

practitioners and researchers. On one hand the interests of the development agencies and donors were evidently more focused on the quantification of the programme effects, through the proposal of gender indicators. Conversely, the research centre generally appeared more interested in the process behind the development of M&E tools, as might be indicators. None of the selected projects was a specific gender equality aimed intervention.

2.4.1 The PAPSEN programme

With regards to the 1st and 2nd research phase, data were collected in the framework of a drip-irrigation horticultural project in Senegal, the PAPSEN project. The PAPSEN is the Support Programme to the National Agricultural Investment Plan in Senegal (PNIA), jointly managed by the Italian Agency of Development Cooperation (AICS, the former DGCS), the Senegalese Ministry of Agriculture and Rural Equipment (MAER), and the Israeli International Cooperation (MASHAW). The project presented since the beginning a gender sensitive lens since the main intended beneficiaries were women farmers. This project has been implemented since 2013 in two diverse areas of the country, through a different set of specific activities. The first component of the project has been developed in three central regions of Senegal (Thiès, Fatick, and Diourbel) part of the so-called *Bassin Arachidier* and it was primary focused on the improvement of the local horticultural supply chain, including the final farmers revenues and the general market conditions. The second component of the project, focused on the improvement of the rice production systems, has been realized in two southern Senegalese regions (Sédhiou and Kolda). The Ph.D research has been realized within the first component of the project, concerning horticultural activities in the central area of the country.

This project component was aimed to improve the overall life, food security and production conditions of local small farmer organizations (women, men, and mixed organizations) providing a system of drip irrigation, a services and training centre, and technical assistance. Basically, the project intended to apply a “communal system” of the cultivated land using a common water source to irrigate a total of 70 horticultural perimeters (each of them ranging from 5 to 10 hectares for a total of around 400 hectares). In practice, the whole perimeter was divided into individual plots, with several management committees entitled to take decisions about the perimeter management.

The research was conducted between 2013 and 2015 across the Thiès and the Diourbel regions. Data collected during these phases of the research were integrated with statistical information coming from the national and regional statistic surveys (made by the National Statistic Agency, ANSD) and with interviews and meetings with a selection of local key informants and stakeholders.

With regards to the primary data collected during the field work, the main interviews' and meetings' respondents can be gathered in the following categories: public officers (e.g. from the Ministries of Agriculture, of Economics, and of Women and Gender Equality Promotion), local statisticians, agents of the local extension services, representatives of international donors, and development actors (including NGOs, research centres, and gender experts).

2.4.2 The INAE project

The third research cycle (between 2016 and 2017) was inserted in the framework of the IDAE (*Institutionalization of Agroecology*) research project, simultaneously conducted since 2016 in three different countries (France, Argentina, and Brazil).

The project goals were both the study of the agro-ecology processes of institutionalization in terms of public policy, higher education and

knowledge creation dynamics and the analysis of the forms and the ways of coexistence between agroecology and other agricultural models in Brazil.

In particular the Ph.D research was realized in the Brazilian Amazonia, where the local project component was managed jointly by the following partners: CIRAD (French Agricultural Research Centre for International Development); EMBRAPA *Amazônia Oriental* (the Brazilian Agricultural Research Corporation); Museo Paraense Emílio Goeldi; University of Brasilia (Sustainable Development Centre - CDS); UFPA (Federal University of Pará (*Núcleo de Ciências Agrárias e Desenvolvimento Rural* - NCADR).

The research project, implemented within the local research platform “Forests, agriculture, and territories in the Amazon”, was aimed to study how it is possible to reconcile the environmental protection issues and support the rural populations across the Amazonia region, with its huge agricultural potential and crucial ecological role at global level. The main project intend was to jointly work with the local stakeholders in order to develop alternative and environmentally-friendly production systems and to gather every local stakeholder in support of this objective.

2.5 The scheme of the empirical material

The main sources of empirical material for the three research cycles (1 and 2 within the PAPSEN programme, and 3 within the IDAE project) are illustrated in Table 1.

Table 1. Empirical material and main research outcomes

RESEARCH CYCLE (1, 2, 3)	PROJECT LOCATION (Senegal: S; Brazil; B)	SOURCES OF EMPIRICAL MATERIAL
1; 2	S	Literature review on gender issues and agriculture (focus on gender indicators, horticulture and rural water features) in Senegal
3	B	Literature review on gender, sustainability, indicators and agroecology.
1; 2;3	S; B	Regular meetings with the programme/project staff and the local partners
1; 2	S	Reflections, suggestions and assessment on the best theoretical and methodological methods to apply during the research (2016) done by external experts as WUR professors and researchers
1; 2; 3	S; B	Analysis, debriefs and reflections on the evaluation methods, processes and outcomes with some main selected stakeholder and key informants
1; 2;3	S; B	Data provided by the national statistic agencies (i.e. ANSD: Agence Nationale de la Statistique et de la Démographie; IBGE (Instituto Brasileiro de Geografia e Estatística)
2	S	Horticulture water sources survey
1	S	Testing of women interviews
1;2	S	Analysis of project technical documents
3	B	Focus group
3	B	Semi structured interviews
RESEARCH CYCLE (1, 2, 3)	PROJECT (Senegal: S; Brazil; B)	FIRST OUTCOMES
1;2	S	International presentations (Cattolica University; International EXPO Milan; CUCS Brescia University)
3	B	Public presentations and discussion with key informants and experts: Dakar (May 2015); Toulouse (November 2016); Belem (April 2017)
3	B	On-going jointly publication (CAHIERS D'AGRICULTURE eds.)
1;2	S	Several technical reports, one published book chapter (SAGE eds.); one published paper (Water MDPI eds.)

2.6 General considerations

Studying rural gender issues in the framework of these two programmes was a quite interesting and useful challenge because both the programmes did not were explicitly designed to promote gender equality

issues. However the gender component was always more or less implicitly embedded in the selected programmes for the following reasons. First, because the main beneficiaries of the PAPSEN programme in Senegal were women small farmers, second because in the specific area of the Brazilian Amazonia, the main exponents of agroecology are generally women, third because, as largely stressed in the previous part of the introduction, gender and sustainable issues are strictly connected.

Sahel and Amazonia are two vulnerable and precarious contexts, due to various environmental and socio-economic reasons (excessive dryness or rather rainfall, climate change threats, unsustainable land use, lack of infrastructures, etc.) in which the rural women situation is quite different, but where at the same time, several gender inequalities in terms of acknowledgement, access to agricultural inputs, training and extension services, and suitable supported policies can be observed.

This preview allows to understand the many complexities met by researchers and practitioners in this field of analysis. First, when they outline the concepts of gender issues, rural development, and sustainability; second, when they try to analyse and propose the suitable tools and methodologies for assess and measure potential changes and connections between these previous dynamics; third, when they challenge the need to easily communicate and actively shared the outcomes of their work; and forth, when they want to actually use and apply the elaborate theories, in order to actually influence the decision-making process. Thus, studying gender indicators in rural contexts is not an exact science but an on-going, guesswork and subjective trial.

3. THE ROLE OF GENDER INDICATORS IN RURAL DEVELOPMENT PROGRAMMES

*Francesca Alice Centrone**, *Bettina Bock^o*, *Angela Mosso**, *Angela Calvo**

**Department of Agricultural, Forestry and Food Sciences, Turin University*

^oWU Social Sciences, Rural Sociology Group, Wageningen University

© 2017 CAB International Publishing.

Centrone, F. A., Bock, B. B., Mosso, A., & Calvo, A. (2017). The Role of Gender Indicators in Rural Development Programmes, in Bock, B. B., Shortall, S. Eds. (2017) *Gender and Rural Globalization. International Perspectives on Gender and Rural Development*, Centre for Agriculture and Bioscience International: Wallingford, UK, 304.

3.1 Introduction

This chapter contributes to the debate among policymakers, development practitioners and researchers regarding the use of gender indicators in rural settings in the global south; it highlights both the main obstacles and the most recent attempts to develop novel and more insightful indicators.

Feminist researchers have repeatedly underlined the need for reliable gender-specific statistics to represent the position, relations and real involvement of women and men within rural development programmes. Currently, this area has also become a focal point for policymakers, who must demonstrate the necessity for targeted interventions and build alliances to support a specific approach and programme (because “what gets measured, gets managed”). Gender indicators may simultaneously be useful for development practitioners in different stages of project management, such as for determining the feasibility of a project, monitoring its progress, and evaluating its impacts.

Indicators are commonly defined as tools that summarise substantial amounts of data with the purpose of representing a dynamic and

complex situation and assessing (the direction of) change. Investigating the lives of rural women, in term of status and opportunities, comprises a complex issue that requires the analysis of several empowerment factors, such as access to health, education, governance, knowledge and technology, whose influence often considerably varies across different contexts and geographical scales (Calvo, 2013). Moreover, these variables are interdependent and interrelated in complex ways that are difficult to represent in an objective and understandable manner. Indicators may be useful in this context, particularly the most recent generation of multidimensional indices (originally applied to the more generic concepts of poverty and development). Indeed, these indices are more valuable than ordinary statistics by virtue of their potential to reflect this complexity, summarise various information in a single number and thus increase the range of analysis beyond a unilateral interpretation.

Many gender-sensitive indices have been developed in recent years. Several indices have been abandoned due to technical and other substantial limitations (e.g. the lack of gender disaggregated data at regional and local levels, range of analysis, critical and difficult processing, lack of access to information, and costs of the data-gathering process). New attempts have incorporated these experiences and lessons learned from previous failures and provide a better understanding of what an indicator cannot achieve and how to complement it with other instruments. These limits (but also the improvements) are particularly important when elaborating gender indicators for rural areas, where there is an evident lack of information and recognition of women as “actual farmers” and economic actors and where the difficulty for women of effectively participating in the formulation and implementation of agricultural and rural development processes is most evident (Bock, 2016).

Multidimensional gender indicators are typically developed at the national level to support international comparisons. However, they provide an average image of national gender relations, which hides potentially quite substantial diversities at the local level. Several studies (Narayan 2005 in Vaz et al., 2016) have stressed that contextual factors often matter much more for women's empowerment than individual differences (Malhotra & Schuler, 2005) (e.g., particularly in relation to marital violence, microfinance, fertility choices, and political participation; see Mason & Smith, 2000; Koenig et al., 2006; Desposato & Norrander, 2009). Depending on the different contexts, a woman may be "empowered" in a particular dimension of her life but not in another; moreover, according to each particular status, origin, and culture, "what empowers one woman might not empower another" (Cornwall, 2016, p.3). This statement indicates that contexts differ with respect to the relevance of empowerment criteria, and studies may reach different conclusions depending on the aspects of empowerment and relative indicators examined (Haile et al., 2012). Thus, it is important to develop indicators that are sensitive and adaptable to differences in context.

This paper discusses the importance of gender indicators based on experiences in three rural regions in Senegal, an area in which we developed multidimensional gender indicators to support practitioners, particularly small and local actors, in project management issues and to inform policy makers. This chapter raises the following main question: how can we translate the gender indicators applied at the (inter)national level into context-sensitive indicators that are useful for rural development programmes at the regional level? First, a general overview of the major multidimensional gender indicators is provided; these clearly reflect the changing ideas regarding gender issues in rural development. Second, we present and discuss our attempt to develop indicators that can support rural gender projects at the local level. We subsequently stress the next steps in the process, in particular, the need

to test these proposed indicators in the field, as well as to discuss the empowerment criteria and indicators that are most relevant to include with local women, practitioners and beneficiaries. A brief reflection is ultimately provided in which we highlight the main implications, constraints and challenges to overcome for the future development of rural gender indicators.

3.2 Gender indicators: an overview

The history of gender indicators began approximately twenty years ago on the occasion of the Fourth World Conference on Women, which was convened by the United Nations in September 1995 in Beijing, China. Since that time, gender indicators have become more complex and manifold. Moreover, it continues to be difficult to transpose questions into indicators; for example, subjects such as the contribution of women to so-called care and reproductive activities typically remain outside of statistics. Table 1 provides a brief overview of several of the most relevant gender indicators proposed to date and specifies their scale unit (national or intra-national) and the investigated area (urban or rural). Far from being a completely exhaustive compendium, the table indicates the sub-indicators that comprise each indicator, aggregated according to nine selected empowerment dimensions. Furthermore, a synthetic list is provided that indicates the main concepts considered within the empowerment dimensions. Many of these indices were elaborated using databases supplied by United Nations agencies (e.g. International Labour Organisations, World Bank etc.), as well as by other national and statistical agencies.

Table 1. Summary of the most relevant gender indicators since the 1990s. (Authors' elaboration.)

With respect to the initial indicators, which may not be specifically gender oriented, the Human Development Index (HDI) is also included in this list because it represents the starting point for elaborating a more accurate and gender-inclusive human development indicator. The inventors of this indicator (Anand & Sen, 1995, 2000) also contributed to the development of a greater gender vision by promoting the study of the Gender Development Index (GDI), with a focus on highlighting gender inequalities in the achievement of human development goals. The GDI was based on the same sub-indices as the HDI (life expectancy, education and earned income); however, it was divided by sex.

In 1996, the United Nations Development Programme (UNDP) published the Gender Empowerment Measure (GEM), which specifically referred to the participation level of women and men in the economic and political life of selected countries (UNDP, 1996). The GEM used three variables to indicate the participation of women in terms of political presence, access to professional opportunities and bargaining power.

The beginning of the 2000s saw several new proposals for gender indicators. In 2000, Dijkstra and Hammer introduced the Relative Status of Women (RSW), which was calculated as the arithmetic average of the ratios between the female and male indexes for education, life expectancy and returns to labour (Dijkstra, 2006).

In 2004, the United Nations Economic Commission for Africa processed the African Gender Development Index (AGDI), which aimed to estimate the size of the welfare inequality between African women and men (UNECA, 2011).

In 2005, Social Watch published the Gender Equity Index (GEI) to stress gender differences in political, economic and cultural power (Social Watch, 2005).

Between 2005 and 2006, the World Economic Forum, in collaboration with Harvard University and the London Business School, introduced

another indicator, the Gender Gap Index (GGI), which was based on four domains: economic participation and opportunity, realisation of those goals related to education, political empowerment and health (World Economic Forum, 2006; Lopez-Claros & Zahidi, 2005).

In 2009, the Organisation for Economic Co-operation and Development (OECD) produced the Social Institutions and Gender Index (SIGI) to indicate how social institutions can influence gender inequality. This indicator also introduced a civil rights component, which substantially influenced the status and empowerment of women (Branisa et al., 2009). In particular, it considered the sub-indices of different social domains: family, physical integrity, civil liberties and ownership rights (Jütting et al., 2008).

Another important indicator, despite the absence of gender in its calculation, introduced in 2006 by the International Food Policy Research Institute (IFPRI) and still in use, is the Global Hunger Index (GHI); it is calculated using data collected by international agencies at the governmental level (IFPRI et al., 2012b). Although the mention of “gender” is not explicit in its reports, the GHI represents a crucial indicator for inclusion in gender analysis as at times the unpredictable current global climate and market (e.g., as a result of floods, droughts and the improper use of land for growing bio-fuels or products for the exports-oriented market) may cause different types of shocks that affect the crops of both women (typically in the case of environmental crisis) and men (more often a result of market instabilities) (Carr, 2008).

Since 2010, within the most recent UNDP Human Development Reports, new concepts have been introduced in relation to gender disparities, such as vulnerability, resilience and sustainability. In particular, the most recent UNDP reports no longer refer to the GDI (Gender Development Index, described earlier); instead, the reports cite the Gender Inequality Index (GII). Basically, the GII of a nation reflects the disadvantages

caused by deprivation in three domains: reproductive health, empowerment and the labour market (Seth, 2009).

Another apparently gender blind indicator is the Multidimensional Poverty Index (MPI), which was launched by the Oxford Poverty & Human Development Initiative (OPHI) and the George Washington University in 2010 and was designed to analyse the “poverty” level of a country and overcome the limits of the previous Human Poverty Index (HPI). The MPI measures the most serious forms of deprivation in the dimensions of health, education and standards of living, with respect to both the number of disadvantaged people and the intensity of their deprivation. Despite the lack of gender-specificity, mostly because of the unavailability of gender disaggregated data as described by several authors (see, for instance, Alkire & Santos, 2014), the MPI deserves to be included in this overview. In the presence of deprivations in education, health and public service access, particularly in several southern countries, women are often the main disadvantaged subjects.

In 2012, during the 56th session of the UN Commission on the Status of Women, the Women’s Empowerment in Agriculture Index (WEAI) was presented; this index was promoted by the US government’s Feed the Future Initiative in cooperation with the Oxford Poverty and Human Development Initiative (OPHI) and the International Food Policy Research Institute (IFPRI). This complex but exhaustive indicator measures the role, representativeness, empowerment and inclusion of women in agriculture, taking into account five sub-domains: production, access to and decision making over economic resources, control over income, leadership and time management (Alkire et al., 2013; IFPRI et al., 2012a). The WEAI is one of the few indices that assesses the rural gender dimension; however, because it requires a robust methodology and detailed local surveys, which entail strong investments in human and financial resources, it may be relatively difficult for small local development actors to maintain or apply it.

From this long list, we can deduce that gender empowerment comprises a difficult and complex concept, not only to define, interpret (see Cornwall, 2016; Kabeer, 2011; Syed, 2010) and implement in practice but also to measure and assess (Kabeer, 1999; Malhotra & Schuler *ibid.*; Schuler, 2006; Charmes & Wieringa, 2003; Dijkstra, 2002; Klasen & Schuler, 2011). Difficulties particularly increase when the empowerment analysis refers to the most immaterial aspects of life, such as decision-making power, autonomy over important life choices, self-confidence and awareness of women's rights (Cornwall, 2016). However, it is clear that many efforts and studies over the previous 20 years have improved the quality and scope of gender indicators, thereby making them more precise and allowing them to address and measure multiple aspects of human – and women's – lives. Nevertheless, there are several remaining questions. First, there is a lack of intra-national studies that propose gender indicators, which would be helpful for promoting local specific interventions (such as development programmes managed by small NGOs or similar). Second, there is an insufficient consideration of rural areas. If gender biases are present at the urban level, they are often more evident in rural settings, which, after all, are the most favoured spaces of many international development interventions.

These constraints open the door to our specific research question: how can we overcome these problems by proposing rural gender indicators that can be applied at the local level by small development actors?

Two different options may be viable:

- 1) via the use of specific/ad hoc surveys, applied case by case. However, these surveys have several limits: they are not universally applicable, they are relatively expensive in terms of the economic and human resources involved and they change over time;
- 2) via the use of available local and/or regional databases to elaborate ad hoc indicators. This second possibility also presents several

limitations related to the lack of completeness, which is predominately a result of missing/unavailable data, and the lack of qualitative aspects. Therefore, we elaborated three rural gender indicators applicable at the local level. As models and starting points for these indicators, we use some of the previously described indicators proposed for international comparisons, as well as data originating from national statistical surveys.

3.3 Background and context

This research aims to demonstrate the usefulness of contextual regional indicators, the possibility of calculating them based on national data, and the ability to translate international and national data into regional information while ensuring that they are context sensitive. The overall idea is to propose regional gender indicators appropriate for multiple purposes: first, as a baseline assessment and then as a tool to track and evaluate progress and changes in empowerment over time and during the implementation phases of international rural development programmes. Furthermore, these indicators may be viewed as a means to foster and potentially (indirectly) promote inclusive rural development projects (through a greater effective participation of women).

3.3.1 The study area

The research was developed in Senegal, within an international development project that aimed to improve the food security and agricultural production levels (through the use of drip-irrigation systems and technological tools) in three specific regions of Senegal.

The three research regions are situated in the central area of Senegal. Two regions (Fatick and Thiès) are geographically and economically more advantaged (with access to the sea), whereas the third region (Diourbel) is more inland, drought-stricken and lacking an efficient infrastructure. Fatick comprises the more rural region (86% of the total population), whereas in Diourbel, a substantial portion of the population

(64%) resides in urban areas. In contrast, the Thiès region is characterised by a more uniform distribution of the population between rural and urban areas (ANSD, 2013). These different pre-conditions are particularly important in sub-Saharan Africa, as well as in Senegal, where there are frequent, strong imbalances (Sahn & Stifel, 2003; Omigbodun et al., 2010), as well as interconnections (Tacoli, 1998), between rural and urban contexts; these are even more evident when examining women's empowerment.

In these three regions, women are numerically slightly higher than men; however, it is not possible to determine whether they are more prevalent in rural areas, as might be supposed, because of the unavailability of specific gender disaggregated data. In the Diourbel region, the proportion of women of working age in the total population is higher than that of men (77% of the active population). One potential explanation could be the substantial number of male migrants in this region (2.5% of the total), which is greater than the national average (2.3%). Fatick has an increased rate of teenage fertility (153 births per 1,000 women aged 15–19), which is likely a result of the increased density of the population in rural areas (86% of the total) compared with the other two regions (ANSD, 2013).

3.3.2 Methodology. The gender indicator process

The selected development project involved approximately 3,000 women. The project goal for the research was to identify significant and easily obtainable regional and rural gender indicators that focused on three main empowerment dimensions strictly related to the project objectives:

1. Nutrition and food security
2. Health and political representation
3. Access to resources (with a specific distinction between rural, urban and agricultural settings).

First, on the basis of the wide selection of gender indicators developed to date (Table 1), and in accordance with our specific goals and available tools, we initially identified the most suitable indicators for calculation at the regional level as follows:

- Global Hunger Index (GHI)
- Gender Inequality Index (GII)
- Gender Economically Qualified Presence in Agriculture Index (GEQPAI).

Two of these indicators (the GHI and GII) have previously been proposed at the international level and are generally used to perform international comparisons between countries, whereas the third indicator (GEQPAI) was an original elaboration made by the authors. This latter indicator was conceived based on the research purpose, data availability and the observed constraints, but it was particularly designed to specifically address the gap in gender indicators at the rural and regional levels, as previously discussed.

Second, we analysed and selected the main national statistical sources (predominately the surveys conducted by the National Statistical Service of Senegal – ANSD), which enabled us to calculate the selected indicators at the regional and rural levels. We subsequently elaborated three indicators, one indicator for each identified dimension of empowerment, for each sample region, with necessary adaptations to allow comparison with the initially intended indicators (see the following paragraphs). Finally, we discussed the main outputs, criticisms and potentialities of these regional gender indicators and next steps to be taken.

3.3.3 The Undernourishment Index (UI)

The initial purpose was to calculate the Global Hunger Index for each sample region. The GHI highlights the successes and failures in hunger reduction strategies and ranks countries on a 100-point scale, where

zero is the best score (no hunger) and 100 is the worst. The GHI combines three sub-indicators (Table 2), giving equal weight to each (percentage of undernourished individuals, percentage of underweight children under five years old, and infant mortality rate in children under five years old) (IFPRI et al., 2012b). However, in this study, it was not possible to calculate the GHI because the proportion of undernourished individuals at the regional level was not provided by the national statistical agencies. Thus, the Body Mass Index¹ (BMI), which represents a parameter used to discriminate the undernourishment of the population, was included. Specifically, BMI values of 18.5, 17.0, and 16.0 were proposed as universally valid thresholds below which an individual (male or female) could be suffering from mild, moderate, or severe nutrition problems, respectively (Bailey & Ferro-Luzzi, 1995). For our specific elaboration, we selected the following scale: if $18.4 < \text{BMI} < 17$, a chronic energy deficiency is present, whereas if $\text{BMI} < 17$, the malnutrition is considered severe. We used the percentage of the population of each region with a $\text{BMI} < 18.4$, starting with data provided by the ANSD report published in 2012 (ANSD, EDS-MICS 2012). For the GHI, our *Undernourishment Index* (UI) comprises a simple average of its sub-indices: it ranges between 0 and 100 and indicates the percentage of the population that may suffer from nutritional and environmental problems.

3.3.4 The Adjusted Gender Inequality Index (AGII)

The second intent was to calculate the Gender Inequality Index at the regional level according to the same criteria adopted by the Human Development Report (HDR). It was nearly feasible, and we used the same method proposed by the UNDP (UNDP, 2011); however, we were

¹ According to the World Health Organisation, the body mass index (BMI) is defined as an individual's weight in kilograms (kg) divided by the square of the individual's height in metres (m²); it is an attempt to quantify whether an individual is underweight, normal weight, overweight, or obese.

again obliged to make an adjustment. Instead of using the proportion of women who occupy seats in parliament (information not provided within the national statistical surveys), we considered the proportion of women who occupy seats in local institutions; these data were obtained from alternative statistical sources (see the subsequent description). Therefore, we refer to this index as the *Adjusted Gender Inequality Index (AGII)*. Similar to the GII, the Adjusted Gender Inequality Index is a measure that captures the loss in achievements as a result of gender disparities in the dimensions of reproductive health, empowerment and labour force participation. The values range from 0 (perfect equality) to 1 (total inequality). The AGII is a composite indicator that involves two sub-indicators to assess women's reproductive health (the maternal mortality ratio and the adolescent fertility rate), two sub-indicators to evaluate gender empowerment (educational attainment, secondary and above, and the presence of women and men in local institutional posts), and the gender labour force participation sub-indicator (Table 3).

3.3.5 The GEQPAI, the GEQPRI and the GEQPUI Indices

At the regional level, the UI and AGII do not indicate gender differences in terms of active (and economic) presence in the countryside or in terms of access to resources. Thus, beginning with the available information provided by Senegalese national statistical surveys (ANSD: SES 2011, ESPS I 2005-2006, ESPS II 2011) and divided by sex, an indicator of the significant presence of women and men in agriculture was calculated for each study region. On the basis of two types of constraints, limited data availability and the desire to include only the most influential factors affecting the different levels of access to resources, we considered three sub-indices. These sub-indices (all divided by sex) used to calculate the main indicator (referred to as the *Gender Economically Qualified Presence in Agriculture Index, GEQPAI*) are as follows:

- i) the female/male adult literacy rate
- ii) the female/male ratio of the economically active population in agriculture
- iii) the female/male proportion of resource managers in agriculture with respect to the women/men who are economically active in agriculture.

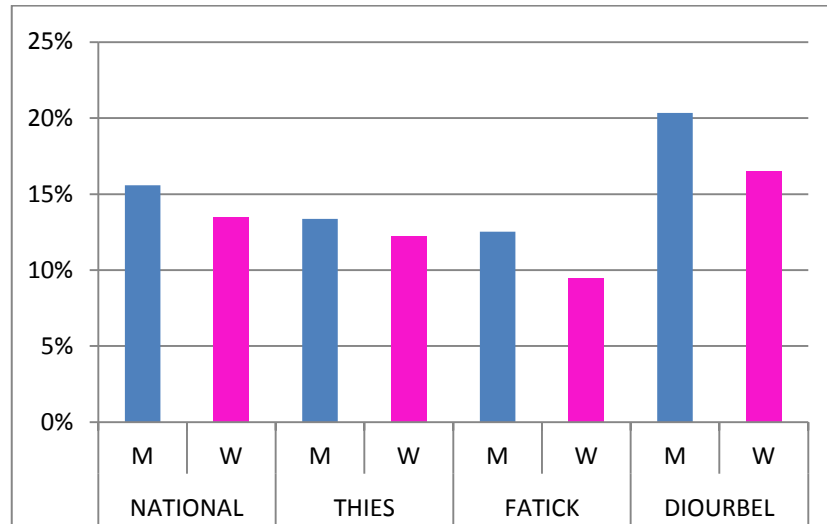
The same indicator was calculated at the rural (GEQPRI) and urban (GEQPUI) levels, with the aim of investigating and highlighting as much as possible the local/contextual gender differences within each sample region. In addition to other multidimensional indicators (for example, the HDI), the GEQPAI (the GEQPRI and the GEQPUI) are averages that range between zero and one. In particular, indicator values closer to 1 indicate smaller differences between women and men as qualified individuals in agricultural, rural and urban areas.

4 Research findings

In relation to the empirical elaboration of the gender indicators, the main output of the UI concerns the Diourbel region (Figure 1), in which the UI is approximately 20 % for men and 17% for women: thus it is consistently compared with the GHI of Senegal, 13.8 (IFPRI et al., 2012), with worse values for both women and men.

This finding indicates substantial nutritional problems in this particular region.

Figure 1. Undernourishment Index (UI) of women (W) and men (M) at national and regional levels, Senegal. (Authors' elaboration.)



With respect to the sub-indicators (Table 2) as a means to understand the main factors that affect the final value of the UI, the indicators of child under-nutrition (19%) and infant mortality (1.04%) are the most influential/explicatory elements with regards to the Diourbel region.

Table 2 Sub-indicators and parameters for calculation of the Undernourishment Index (UI) at national and regional levels, Senegal. (Authors' elaboration.)

SUB-INDICATORS	NATIONAL		THIES		FATICK		DIOURBEL	
	Men	Women	Men	Women	Men	Women	Men	Women
Undernourished children, age < 5 (%)	18	22	15	20.8	11	16.1	19	29.5
Children mortality rate, age < 5 (%)	0.87		0.53		0.88		1.04	
Population with BMI <18.4 (%)	28.2	22	24.2	20.8	25.3	16.1	40.9	29.5
UI (%)	15.6	13.5	13.4	12.2	12.5	9.5	20.3	16.5

Moreover, a distinctive feature is related to the greater value of the UI exhibited by men compared with women.

This finding, which has been previously reported in other studies in reference to Ethiopia (Hadley et al., 2011; Bailey & Ferro-Luzzi, *ibid.*), holds nationally and in all three regions of the sample, with the most dramatic differences between women and men being observed in the Diourbel region (20.3%). This output was simultaneously matched with the frequent and increasing phenomenon of obesity diffused among middle-aged and elderly Senegalese women (particularly at the urban level).

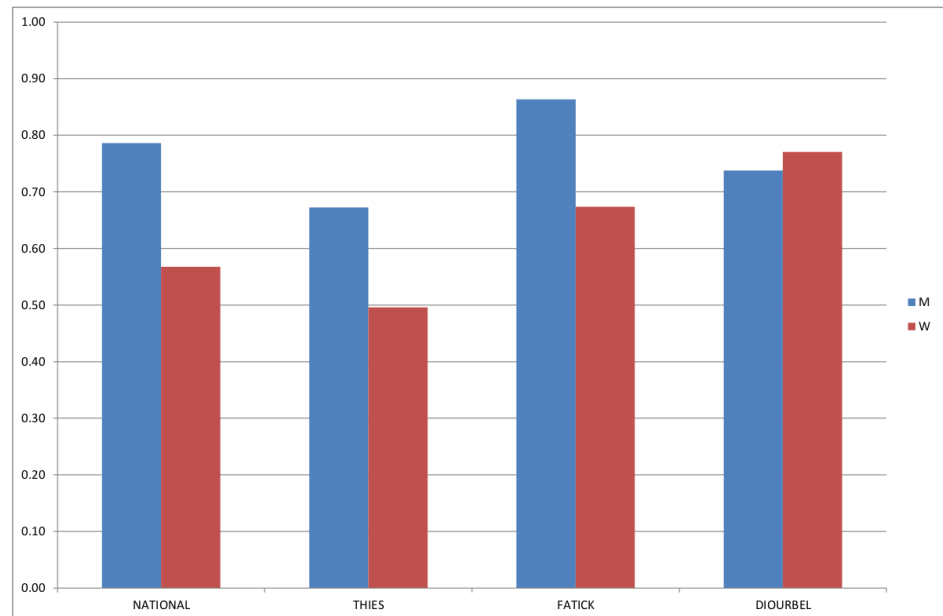
In addition, nutritional and health studies (Macia et al. 2010; Duboz et al., 2012) have demonstrated significantly different BMI values between women and men, both for situations of undernourishment ($BMI < 18.4 \text{ kg/m}^2$) and obesity ($BMI > 30 \text{ kg/m}^2$).

In-depth and more disaggregated analyses should be conducted at the local level to specifically understand at which ages, where and why these differences are present.

Specifically, investigation should focus on local factors (distinguishing between rural and urban levels and making a cross comparison with different classes of age) and other factors (such as education and marital status) that may have greater effects on the nutrition levels of the target individuals.

If we next assess the second indicator (the AGII), the findings indicate that the regional indicators exhibit values similar to those of the national indicators, which enhances the applicability and reliability of the AGII. There is a small difference in relation to the Diourbel region, in which the AGII confirms the worst situation (0.624), with increased inequalities compared with the indicator for the entire country (0.54) and the other sample regions (Figure 2).

Figure 2. Adjusted Gender Inequality Index (AGII) for women (W) and men (M) at national and regional levels, Senegal. (Authors' elaboration).



Furthermore, as shown in Table 3, we can observe that “our” AGII calculated at the national level (0.557) is slightly higher than the GII reported in the Human Development Report of 2013 (0.54); our value is moderately higher in the Thiès region (0.577) and more so in the Fatick (0.611) and Diourbel (0.624) regions (Table 3).

Table 3 Sub-indicators and Parameters for calculation of the Adjusted Gender Inequality Index (AGII) at national and regional levels, Senegal. (Authors’ elaboration.)

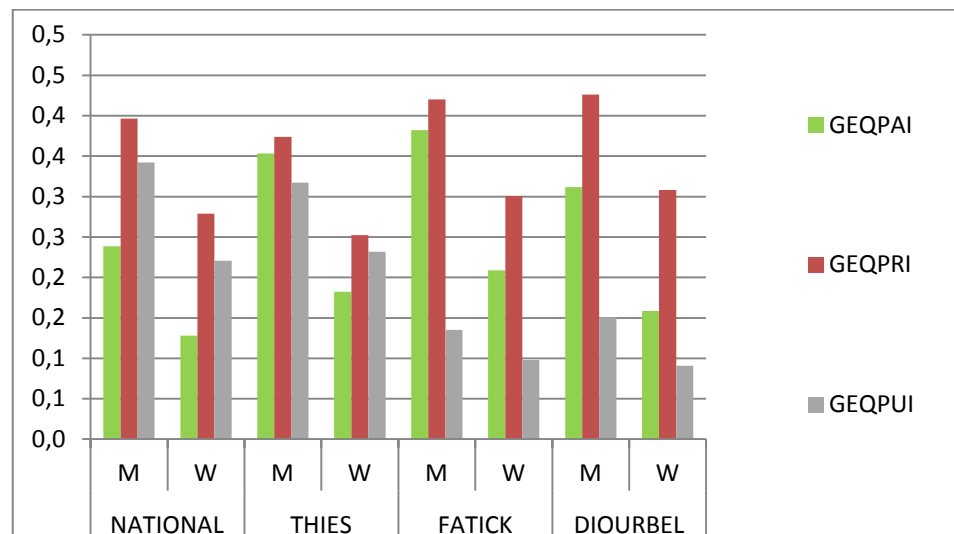
SUB-INDICATORS	NATIONAL		THIES		FATICK		DIOURBEL	
	Men	Women	Men	Women	Men	Women	Men	Women
Maternal mortality ratio (deaths per 100,000 live births)		392		544		381		296
Adolescent fertility rate (births per 1,000 women aged 15–19)		106		100		153		110
Seats in institutions (%)	71	29	75	25	85	15	96	4
Pop. with at least II level of education (%)	13.7	9.6	9.8	7.4	6.9	4.2	4	2.6
Active population (%)	78.6	57	67	50	86	67	74	77
AGII		0.557		0.577		0.611		0.624

An upward shift of the AGII indicates greater diversity and inequality in terms of opportunities for women compared with men. In the Diourbel region, however, the proportion of women of working age in the total population is slightly higher than that of men; this represents a potential source of workers and suggests eligible targets (refer to active population, Table 3). One potential explanation is the greater number of male migrants in this region, 2.5% of the total population (ANSD, 2013), compared with the other regions. If we focus on educational attainment, the main insight originates again from the Diourbel region, which exhibits a very low education level (approximately one third lower than the national average) compared with the other regions.

The higher rate of teenage fertility in Fatick is likely justified by the increased density of the population in rural areas (86%, ANSD, 2013) compared with the other two regions. Finally, the Thiès region globally appears to be a relative “best” example, particularly in terms of education and political representation. However, despite these positive

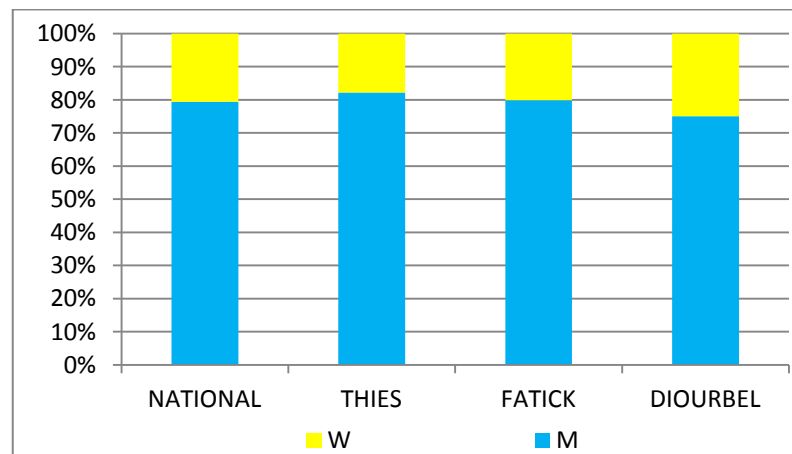
results, this region exhibits the highest maternal mortality rate (54.4%), as well as the lowest proportion of economically active women (50%). Concerning our third indicator (Index of Gender Economically Qualified Presence in agriculture (GEQPAI), rural (GEQPRI) and urban (GEQPUI) contexts), in both the rural and urban contexts the differences between men and women with paid work (who are therefore economically recognizable and consequently 'qualified') are low (Figure 3); however, in all cases, the index of the economically qualified presence of women is always lower than that of men. The worst situation, in terms of economic aspects, is again associated with Diourbel, with the exception of the index related to the rural sector (the GEQPRI) which indicates that women in this region appear to be slightly more qualified and economically active in this dimension.

Figure 3 Indices of the Gender Economically Qualified Presence in three different contexts (agricultural, rural and urban: GEQPAI, GEQPRI and GEQPUI) at national and regional levels, Senegal. (Authors' elaboration.)



The GEQPAI clearly highlights the agricultural and rural vocation of the three sample regions in relation to both women and men. The proportion of women who appear to have increased possibilities to be economically qualified in agriculture is highest in the Fatick region, which comprises the most agriculturally oriented region in the sample. This positive result is likely explained by the heavy weight of the sub-indicator of agricultural resource managers (which may include access to and management of financial resources, skills, inputs, technical training, extension services and technology) in relation to the total indicator. In particular, in an independent analysis of the sub-index related to resource managers in agriculture (Figure 4), the differences between women (in yellow) and men (in blue) are drastically evident.

Figure 4. Distribution of resource managers (women (W) and men (M)) in agriculture at national and regional levels, Senegal. (Authors' elaboration.)



As clearly indicated in Figure 4, in all three sample regions (despite their reciprocal general differences), women are largely under-represented in resource management. Women are considered to be economically active in agriculture (Table 3), but they are not actually responsible for

the resources; this indicates that women may act more as a general workforce than as skilled entrepreneurs. This reality evidently entails dependence and contributes to the randomness and unsustainability of a female presence that is economically active today, but may not be tomorrow. The resource management shortcoming implies several remaining questions: is it a problem of land access and ownership or a failure of access and availability of inputs, machineries, skills and resources for farming activities? Both? To what extent? The multidimensional gender indicators may serve as a tool to achieve a relatively quick overview of particular aspects of empowerment and their relative differences; however, to adequately answer these open questions, further in-depth investigations (also more local participatory indicators) are required.

5. Discussion

This research promotes the fundamental importance of applying contextual gender development indicators to specific intervention areas. The investigated regional indicators enable an explicit understanding of how and how much the three sample regions differ from each other, particularly in terms of nutrition, empowerment and access to resources. In our case, the role played by regional indicators is particularly evident when we examine the most vulnerable areas (nutrition and general empowerment) and those areas with lower gender competences to manage agricultural resources, such as the Diourbel region, where few women manage paid work. The first direct implication in terms of policies and project management issues is related to the necessity of designing punctual interventions that can fill the specific gaps and deficiencies measured at the local level. This finding indicates, for example, that in the most critical contexts that result from gender institutional and infrastructural failures, prior to implementing “advanced” agricultural development projects, it should first be necessary to enhance the

empowerment and education levels of women and girls and only then to progressively and step by step enforce the most appropriate economic and technological aspects. This recommendation is particularly valid with regards to the real sustainability and legacy of rural development projects. In contrast, the areas in which the skills, potentialities and presence of women are more widespread and recognised (such as the regions of Fatick and Thiès in the sample) appear to comprise more suitable contexts for the effective implementation of more productive and technologically oriented agricultural development programmes. We argue that in these latter areas, it may likely be easier for women to adopt enhanced technologies in order to efficiently improve the quality and quantity of their production. In any case, we suggest that it is necessary to carefully select the goals, targets and activities of “generalised” food security projects, conducting local surveys to understand whether, where and the extent to which gender discrepancies are present. Otherwise, development practitioners risk implementing the same “package” of gender-oriented project activities in territories with extremely different starting conditions.

As indicated by methodologists (see for instance Ritchie et al., 2013; Metso & Le Feuvre, 2006) in most cases, the initial theoretical research design is subordinated to specific contextual and practical findings that require modification and adaptation of the initial methodological intent (for indicator elaboration) along the pathway. Therefore, conscious of the limits and the necessary adaptations throughout the research process, as well as on the basis of available data and final outcomes, we suggest that our translation of international gender indicators to the regional scale may positively contribute to the better discovery of local differences in terms of gender empowerment achievements (or lack thereof).

The main evidence for the importance of “in-situ” gender indicators arises from the case of the Diourbel region, which exhibits the most

different values or deep deficiencies in terms of empowerment (such as access and equality regarding education, inputs, socio-politic representation, and financial resources) compared with the national indicators. Furthermore, this study demonstrates that national statistical databases allow the deduction and development of regional indicators with very similar values to the national indicators, as proposed by international agencies and institutions. Thus, these indicators may also be attainable for “small” international development actors, whose aim is obtain an “immediate”, global, comparable, and easily attainable picture of gender equality at the local and regional levels. Consequently, although some scientific value and reliability may be lost, regional gender indicators can play an important role in supporting, from the beginning, the shape and implementation of most adapted rural development projects. Their use implies a decrease in the high costs required for the M&E phases and contributes to the most effective “operationalisation” of gender empowerment in southern countries.

6. Conclusions

In answer to our initial question regarding how and whether it is suitable to adapt international indicators to regional and local contexts, we can state that yes, this attempt is useful because it highlights punctual differences (i.e., “what, where and whom”) in terms of gender empowerment achievements and/or failures with respect to specific contexts. This knowledge may facilitate the better design and implementation of gender-oriented interventions within rural development and agricultural programmes. In particular, the translation of indicators from an international to a regional scale is effective and can be used as an intermediate (and more easily achievable) monitoring-evaluation solution between international comparison operations and household surveys. Simultaneously, even if this exercise has been valuable, additional information is still needed (such as that related to

the most economic and productive aspects of agriculture, e.g., access to inputs, technical training, extension services, and decision making) to fulfil the technical requirements of the applied gender indicators. This type of attempt may also contribute to overcoming the diffused lack of data, to the achievement of a more comprehensive expertise on gender indicators, and to increased exchange, knowledge and awareness of gender issues and methodologies between international, national and local stakeholders.

Furthermore, as a result of this research on gender indicators, we have become increasingly conscious of the necessity of considering and analysing the complete set of mechanisms and processes that underlie the elaboration of these tools. This implies knowing and documenting not only the data collected but also where the data originate, the scale at which the data are collected, who collects the data, and how the data are interpreted and presented (Chant, 2006). As Sen highlighted (Sen, 1987), there are often substantial discrepancies between subjective perceptions of empowerment, equality, and well-being and empowerment as measured by “objective” indicators (Jackson, 1996), such as those previously discussed. Therefore, we are conscious of the future necessity of testing these indicators in the field through the use of more qualitative (see Pradhan, 2003) and participatory approaches or “self-rating” poverty exercises (Chant, *ibid.*), such as Participatory Poverty Assessments (PPAs), as well as on the basis of previous positive attempts of field-based and participatory indicators (see Lilja and Nixon, 2008; Njuki, et al., 2008; Xiaoyun & Remenyi, 2008). We are simultaneously aware of the controversial incidences behind some participation struggles, including the Participatory Rural Appraisal (PRA) (Mosse, 1994; Cornwall, 2003; Mayoux 1995). Throughout the research, it is also possible, and in some cases potentially dangerous, that the role of indicators as (relatively) new governance and power tools (Davis et al., 2012; Merry, 2009) will become progressively more substantial. They

may be viewed as a “top down” construction, an expression of external and personal views and perceptions regarding the gender equality definition of the authors. Moreover, the increased attention towards impact/effect quantification and the subsequent (wished) better management of the development (and research) project risks critically influencing the answers of the “assessed” individuals. This may occur through both their desire (and also potential fear) to comply (or not) with the expectations of the researchers and as a result of the risk/threat related to not obtaining further investments. These factors may “frustrate” the final outputs and the desired greater subjectivity and quality of the collected information.

In the general debate regarding gender indicators, a main key point includes how to combine the attention to local values, perceptions and characteristics with the need for universal and shared tools. These two different directions have similar purposes; however, they are accomplished through different means, including the following: producing more effective and inclusive rural development processes, particularly in southern contexts, and providing a specific and appropriate weight to the whole actors’ objectives and outcomes. In practice, this implies proposing, discussing and applying new interactive ways to achieve real “data for the people by the people”, which provides the expected “empowered” individuals a meaningful role in the process and returns to them the importance and usefulness of the collected information (in an understandable and accessible manner). Moreover, it also captures their perceptions, level of interest and awareness to fill the gap between theory and practice, framework and field, and counted and unexpected.

Acknowledgements

This work was conducted in the framework of the PAPSEN project in Senegal, an international development project funded by the General

Direction of Development Cooperation (DGCS) of the Italian Ministry of Foreign Affairs and jointly managed with the Senegalese Ministry of Agriculture. The authors thank the DGCS, the director and the members of the Local Technical Unit (UTL) of Dakar (Senegal) and the PAPSEN staff, as well as the ANSD and all of official national and international representatives met during the several field studies, conducted between March 2013 and May 2015, for their support, availability and cooperation.

REFERENCES

Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., & Vaz, A. (2013). The women's empowerment in agriculture index. *World Development*, 52, 71-91.

Alkire, S., & Santos, M. E. (2014). Measuring acute poverty in the developing world: Robustness and scope of the multidimensional poverty index. *World Development*, 59, 251-274.

Agence Nationale de la Statistique et de la Démographie du Sénégal, ANSD (2004). Deuxième Enquête Sénégalaise auprès des Ménages - ESAM II (Households Survey).

ANSD and Regional Statistics Service of Fatick (2009). Situation économique et sociale de la Région de Fatick en 2008 (Economic and Social Situation of the Fatick Region in 2008).

ANSD (2009). Enquête villages de 2009 sur l'accès aux services de base (Villages Survey 2009).

ANSD and Regional Statistics Service of Diourbel (2010). Situation économique et sociale de la Région de Diourbel en 2009 (Economic and Social Situation of the Diourbel Region in 2009).

ANSD and Regional Statistics Service of Thiès (2010). Situation économique et sociale de la Région de Thiès en 2009 (Economic and Social Situation of the Thiès Region in 2009).

- ANSD (2012). Enquête Démographique et de Santé à Indicateurs Multiples (EDS-MICS) 2010-2011. Rapport final (Demographic and Health Survey with Multiple Indicators).
- ANSD (2013). Situation économique et sociale du Sénégal en 2011 (Economic and Social Situation of Senegal in 2011).
- Anand, S., & Sen, A. K. (1995). *Gender inequality in human development: theories and measurement* (Occasional paper 19). United Nations Development Programme.
- Anand, S., & Sen, A. (2000). The income component of the human development index. *Journal of human development*, 1(1), 83-106.
- Bailey, K. V., & Ferro-Luzzi, A. (1995). Use of body mass index of adults in assessing individual and community nutritional status. *Bulletin of the World Health Organization*, 73(5), 673.
- Branisa, B., Klasen, S., & Ziegler, M. (2009). New measures of gender inequality: The social institutions and gender index (SIGI) and its sub-indices. *Courant Research Centre: Poverty, Equity and Growth-Discussion Papers*, 10, Goettingen .
- Bock, B.B. (2016). The Rural. In I. Van der Tuin (Eds.), *MacMillan Interdisciplinary Handbooks: Gender*, volume 2: Nature, MacMillan (in print).
- Calvo, A. (2013). Technology and education in rural women entrepreneurship: approaches and problems in some case studies in Mali and in Italy. *Scientific Journal of Agricultural Economics*, 2(1), 1-16.
- Carr, E. R. (2008). Men's crops and women's crops: The importance of gender to the understanding of agricultural and development outcomes in Ghana's Central Region. *World Development*, 36(5), 900-915.
- Chant, S. (2006). Re-thinking the "feminization of poverty" in relation to aggregate gender indices. *Journal of human development*, 7(2), 201-220.

Charmes, J., & Wieringa, S. (2003). Measuring women's empowerment: an assessment of the gender-related development index and the gender empowerment measure. *Journal of Human Development*, 4(3), 419-435.

Cornwall, A. (2003). Whose voices? Whose choices? Reflections on gender and participatory development. *World development*, 31(8), 1325-1342.

Cornwall, A. (2016). Women's Empowerment: What Works?. *Journal of International Development*, 28, 342–359. doi: 10.1002/jid.3210.

Davis, K. E., Kingsbury, B., & Merry, S. E. (2012). Indicators as a technology of global governance. *Law & Society Review*, 46(1), 71-104.

Desposato, S., & Norrander, B. (2009). The gender gap in Latin America: Contextual and individual influences on gender and political participation. *British journal of political science*, 39(01), 141-162.

Dijkstra, A. G. (2002). Revisiting UNDP's GDI and GEM: towards an alternative. *Social Indicators Research*, 57(3), 301-338.

Dijkstra, A. G. (2006). Towards a fresh start in measuring gender equality: A contribution to the debate. *Journal of Human Development*, 7(2), 275-283.

Duboz, P., Chapuis-Lucciani, N., Boëtsch, G., & Gueye, L. (2012). Prevalence of diabetes and associated risk factors in a Senegalese urban (Dakar) population. *Diabetes & metabolism*, 38(4), 332-336.

International Food Policy Research Institute (IFPRI), Oxford Poverty and Human Development Initiative (OPHI), & USAID Feed the Future Initiative (2012a). *Women's Empowerment in Agriculture Index*, Washington DC.

International Food Policy Research Institute (IFPRI), Concern WorldWide, Welthungerhilfe and Green Scenery (2012b) *Global Hunger Index. The Challenge of Hunger: Ensuring Sustainable Food Security Under Land, Water, and Energy Stresses*, Bonn, Washington DC, Dublin.

- Jackson, C. (1996). Rescuing gender from the poverty trap. *World Development*, 24(3), 489-504.
- Jütting, J. P., Morrisson, C., Dayton-Johnson, J., & Drechsler, D. (2008). Measuring gender (in) equality: the OECD gender, institutions and development data base. *Journal of Human Development*, 9(1), 65-86.
- Hadley, C., Belachew, T., Lindstrom, D., & Tessema, F. (2011). The shape of things to come? Household dependency ratio and adolescent nutritional status in rural and urban Ethiopia. *American journal of physical anthropology*, 144(4), 643-652.
- Haile, H. B., Bock, B., & Folmer, H. (2012). Microfinance and female empowerment: Do institutions matter? *Women's studies international forum*, 35(4), 256-265.
- Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment, *Development and Change* 30(3), 435-464.
- Kabeer, N. (2011). Contextualising the Economic Pathways of Women's Empowerment: Findings from a Multi-Country Research Programme. *Pathways Policy Paper*, Brighton: Pathways of Women's Empowerment RPC.
- Klasen, S., & Schüler, D. (2011). Reforming the gender-related development index and the gender empowerment measure: Implementing some specific proposals. *Feminist Economics*, 17(1), 1-30.
- Koenig, M. A., Stephenson, R., Ahmed, S., Jejeebhoy, S. J., & Campbell, J. (2006). Individual and contextual determinants of domestic violence in North India. *American journal of public health*, 96(1), 132-138.
- Lilja, N., & Dixon, J. (2008). Operationalising participatory research and gender analysis: new research and assessment approaches. *Development in Practice*, 18(4-5), 467-478.
- Lopez-Claros, A., & Zahidi, S. (2005). *Women empowerment: measuring the global gender gap*. Geneva, Switzerland: World Economic Forum.

- Macia, E., Duboz, P., & Gueye, L. (2010). Prevalence of obesity in Dakar. *Obesity Reviews*, 11(10), 691-694.
- Malhotra, A., & Schuler, S. R. (2005). Women's empowerment as a variable in international development. In D. Narayan (Eds.). *Measuring empowerment: Cross-disciplinary perspectives*, 71-88. World Bank, Washington DC.
- Mason, K. & H. L. Smith. (2000). Husbands' versus Wives Fertility Goals and Use of Contraception: The Influence of Gender Context in Five Asian Countries. *Demography*, 37(3), 299-311.
- Mayoux, L. (1995). Beyond naivety: women, gender inequality and participatory development. *Development and change*, 26(2), 235-258.
- Merry, S. E. (2009, March). Measuring the world: indicators, human rights, and global governance. In *Proceedings of the 103rd Annual Meeting* (Vol. 103, pp. 239-243). American Society for International Law.
- Metso, M., & Le Feuvre, N. (2006). Quantitative Methods for Analysing Gender, Ethnicity and Migration. York: *The University of York*. www.york.ac.uk/res/researchintegration/Integrative_Research_Methods/Metso%20and%20Le%20Feuvre%20Quantitative%20Methods%20April,20,2007.
- Mosse, D. (1994). Authority, gender and knowledge: theoretical reflections on the practice of participatory rural appraisal. *Development and change*, 25(3), 497-526.
- Narayan D. (Eds.). *Measuring empowerment: Cross-disciplinary perspectives*, 71-88. World Bank, Washington DC.
- Njuki, J., et al. (2008). Using community indicators for evaluating research and development programmes: Experiences from Malawi. *Development in Practice*, 18(4-5), 633-642.
- Omigbodun, O. O., Adediran, K. I., Akinyemi, J. O., Omigbodun, A. O., Adedokun, B. O., & Esan, O. (2010). Gender and rural-urban differences in the nutritional status of in-school adolescents in south-western Nigeria. *Journal of biosocial science*, 42(05), 653-676.

- Pradhan, B. (2003) Measuring empowerment: a methodological approach. *Development*, 46(2), 1–7.
- Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (Eds.). (2013). *Qualitative research practice: A guide for social science students and researchers*. Sage.
- Sahn, D. E., & Stifel, D. C. (2003). Urban–rural inequality in living standards in Africa. *Journal of African Economies*, 12(4), 564-597.
- Schüler, D. (2006). The uses and misuses of the Gender-Related Development Index and Gender Empowerment Measure: a review of the Literature. *Journal of Human Development*, 7(2), 161-181.
- Sen, A. (1987). The standard of living: lecture I, concepts and critiques. In Sen A. (Eds.), *The standard of living* (pp. 1-19). Cambridge University Press.
- Seth S. (2009). Inequality, Interactions, and Human Development. *Journal of Human Development and Capabilities*. 10 (3), 375–396.
- Silber, J. (2011). A comment on the MPI index. *Journal of Economic Inequality*, 9(3), 479-481.
- Social Watch (2005). No Country Treats its Women the same as its Men: the Gender Equality Index – a New Perspective. In: *Social Watch Roars and Whispers: Gender and Poverty: Promises Versus Action*. http://www.socialwatch.org/en/informelmpreso/pdfs/gei2005_eng.pdf
- Syed, J. (2010). Reconstructing gender empowerment. *Women's Studies International Forum*, 33, 283–294.
- Tacoli, C. (1998). Rural-urban interactions; a guide to the literature. *Environment and urbanization*, 10, 147-166.
- United Nations Development Programme (UNDP) (1996). Human Development Report 1996. Growth for Human Development. http://hdr.undp.org/sites/default/files/reports/257/hdr_1996_en_complete_nostats.pdf

UNDP (2011). Human Development Report 2011. Sustainability and Equity: A Better Future for All. New York. <http://hdr.undp.org/en/statistics/hdi/>.

United National Economic Commission for Africa (UNECA) (2011). The African Gender and Development Index. Addis Abeba.

Vaz, A., Pratley, P., & Alkire, S. (2016). Measuring Women's Autonomy in Chad Using the Relative Autonomy Index. *Feminist Economics*, 22(1), 264-294.

World Economic Forum (2006), *The Global Gender Gap Report 2006*. Geneva, Switzerland: World Social Forum.

Xiaoyun, L., & Remenyi, J. (2008). Making poverty mapping and monitoring participatory. *Development in Practice*, 18(4-5), 599-610.

4. WATER GENDER INDICATORS IN AGRICULTURE. A STUDY OF HORTICULTURAL FARMER ORGANIZATIONS IN SENEGAL.

Francesca Alice Centrone ^{1,2*}, Angela Mosso ¹, Patrizia Busato ¹ and
Angela Calvo ^{1,2}

¹ Department of Agricultural, Forest and Food Sciences (DISAFA),
University of Turin, 2, Largo Paolo Braccini, 10095 Grugliasco (TO),
Italy; angela.mosso@unito.it (A.M.); patrizia.busato@unito.it (P.B.);
angela.calvo@unito.it (A.C.)

² Interdepartmental Research Center for Women's and Gender Studies,
(CIRSDe), University of Turin 10153, Torino, Italy

Received: 10 August 2017; Accepted: 06 December 2017; Published on Water, MDPI:
13 December 2017.

"© 2017 by MDPI (<http://www.mdpi.org>). Reproduction is permitted for non commercial
purposes".

Abstract: This paper intends to contribute to the debate on gender equality and water within the Sustainable Development Goals SDGs 5 and 6. Farmers organizations are often considered key stakeholders whose participation should be fostered to achieve a good water governance in agriculture and irrigation programs. Nonetheless, many water management interventions tackle participation as an instrumental and formal process. A common assumption is that granting sufficient space for women in water management will automatically ensure a greater gender empowerment. Nevertheless, often low importance is given to assessing who really actively participates and benefits from water development projects, favoring the technical aspects. This paper addresses the articulation between gender, water management and

indicators, using male, female and mixed farmer organizations as touchstones in three regions of Senegal. The authors defines a system of water gender indicators grouped into five sections. The first results show more similarities between mixed and female organizations, while the main gender inequalities are visible in the water technique and economic domains. Thanks to this study, we can see how a gender-based analysis may allow to more deeply understand some more or less “hidden” water governance mechanisms and their related implications in terms of project management and policy making.

Keywords: SDGs; gender indicators; water management; irrigation; sustainability; participation

1. Introduction

1.1. Women, Access to Agricultural Resources and Drip Irrigation Systems

In 2014, the United Nations inaugurated a new set of Sustainable Development Goals (SDGs), aiming to substitute the previous Millennium Development Goals (MDGs) as a reference for the new international development Agenda (2015–2030). In order to favor a greater inclusive and participatory process, several consultations were conducted worldwide involving multiple stakeholders. The SDGs include 17 goals, 169 targets and a preliminary proposal of 303 indicators. The 17 goals cover new topics such as climate change, economic inequality, innovation, sustainable consumption, peace and justice [1]. Nevertheless, the SDGs have been subjected to some criticisms, as the excessive importance due to the “quantification” of the development actions and the enormous number of targets and indicators to be achieved [2–4].

Our study may be integrated into the framework of two particular SDGs, SDG 5 (aimed to achieve gender equality and empower women and girls worldwide) and SDG 6 (focused on guaranteeing available and sustainable management of water for everybody). In order to cover these areas of analysis, an overview on water gender management and irrigation issues in agriculture is presented.

Women are generally the main beneficiaries of many food security projects aimed to improve the households' nutrition levels. However, despite this preference, women have difficulty being recognized as actual farmers [5]. Gender mainstreaming is feeble and low importance is given to assessing who really benefits from the projects [6] because the different gender knowledge, education, ability and potential are often not considered, favoring the technical aspects.

In particular, horticulture, more than other food crops, requires technical expertise, first concerning water management issues, considering the large amount of needed water, which is not always easily accessible. In this framework, drip irrigation systems (largely fostered by international donors) are frequently applied to irrigate home gardens aimed to providing vegetables and a most balanced diet, both for self-consumption and for additional selling purposes [7,8]. Drip irrigation (low cost, reliable, laborsaving, and easy to be technologically accepted) uses networks of pipes and tubes to direct water to the soil surface, in order to reduce the water consumption and the losses due to evaporation [9]. It was shown by researchers that drip irrigation can help farmers with saving time, improving health, food security, income, employment and control over resources [10,11].

Despite the advantages, the widespread application of drip irrigation systems presents some constraints [12–14]. Such drawbacks may be technical (e.g. the occlusion of pipes and drip trays in case of high mineralization of water), related to the management and the

maintenance (high purchase, installation and repair costs) or socio-cultural.

In some cases [9], the adoption of drip irrigation systems may increase the existent social and economic inequalities, to the detriment of the smaller and disadvantaged actors. In fact, the FAO (Food and Agriculture Organization) [15] indicated that improved irrigation benefited the bigger and better organized farmers more, especially thanks to their greater capacity to count on additional capital and public support. Other researchers [16] specifically described how women and men appeared to have different incentives for investing time, labor, and capital in irrigation-related activities. In particular, especially in the Latin American context, women are generally associated with sanitation aspects, while the most “productive” uses of water (as the water for irrigation purposes) should be a peculiarity of men [17].

Similar unequal effects for women farmers could be observed even in relation to the implementation of other development interventions as hydropower projects, often translating into an increased workload for the local women, with regard to the collection of water, fodder and fuel wood (due mainly to the raising male migration), but also in a decreased access to the means of production (land, irrigation, water, etc.) [18].

In Sub-Saharan Africa, other constraints prevent a greater implementation of drip irrigation systems, such as the lack of basic infrastructure, the absence of developed markets and the cultural biases towards the active and recognized role of women in agriculture [19,20].

Especially in sub-Saharan Africa, women are often excluded by improved horticulture projects, and they continue to suffer from insecure livelihoods and lack of income-generating activities [21]. Inadequate water access for productive purposes is one of the factors that increases the social, economic and environmental vulnerability and poverty of women and their households [22,23]. In the 1990s, some studies focusing on water access [24,25] shared the “unverified premise that

women's uses of water mainly occur in the domestic or nonmarket sphere, in implicit opposition to men's uses of water, which are believed to be mainly productive and market oriented" [26] (p. 1335). Despite this assumption, some most recent analyses [27–29] have started to contest this dichotomy, highlighting the necessity to make more visible the link between women, irrigation and water innovation processes in agriculture. At the same time, other studies related to the specific field of drip irrigation underlined a general gender blindness in such projects, mainly oriented towards technical issues [6,30].

As underlined also by Van Houweling et al. [31], technical water questions may not be separated from the issues related to the land property and the resources and inputs access. Some researchers [21,32,33] highlighted the same level of productivity between women and men active in agriculture, despite the different input access levels [34]. In practice, there would be no differences between different genders in terms of productivity and agricultural revenues, when women farmers can count on an equal access to resources and sell their crops in the same way as men [35].

The same assumption is valid also in relation to the fair and unequal access and management of technology [36] and technical training [37] even in agricultural contexts. The study of Haile et al. [38] highlighted the relative ease of using of drip irrigation systems that would be particularly suitable for women, provided with proper training. This latter point represents a relatively unexplored issue within the data gathering process, to be taken into consideration for the elaboration of efficient and all-inclusive monitoring and evaluation indicators [39].

1.2. Farmer Organizations and Gender Exclusion Mechanisms

In many interventions, a communitarian management of the irrigation perimeters is required and promoted by the international donors [12]. One of the main adduced motivations is that, by decentralizing to local

institutions the management of water resources, the whole community will benefit, and this will lead to a sustainable use of the resources over time [40]. However, the orientation methods towards entrepreneurial models (rather implied within the drip irrigation projects) may undermine the existent relationship within the local farming systems, as those belonging to the traditional farmer organizations (FOs) [41].

For these reasons, an important dimension, taken into consideration by this study, is related to the link between the farmer organizations (FOs) and the implementation of drip irrigation systems.

FOs are organizations created by the producers to render services to the members of the organizations. We can distinguish four main types of functions, and relative forms of organizations: (1) representing and defending the interests of the producers (as the “Unions”); (2) having economic and technical function (generally cooperatives or professional associations); (3) improving natural resource management (as the water user associations—WUAs—irrigation schemes or associations of forestry operators); (4) fulfilling a social development function (as informal or formal village associations or local development associations) [42]. We can also distinguish other types of FOs on the basis of their gender components—for instance: men, women and mixed organizations. These types of FOs should provide the same type of services to their members; nonetheless, the effective power owned by women organizations and women within mixed organizations appears weaker compared with the male members. As largely stressed by Bina Agarwal [43,44], when women perform substantial decision-making roles within the management committees of FOs, positive effects in terms of sustainable management, use and conservation of commons resources (as water) are frequently observed. Other researchers observed that, when women farmers have a greater access and participation in water issues (especially within irrigation institutions), their performance and revenues, as well as the general household livelihoods, increase [45].

However, at the same time, gender is a critical factor leading to further exclusion mechanisms within the internal decision-making processes of farmer organizations [46].

The women exclusion can be observed looking at some particular type of grassroots organizations such as the water user associations (WUAs). WUAs are intermediate organizations based on the principles of the “Community-based Management (CBM)”, diffused in several areas of southern countries. WUAs are strongly connected with the structural adjustment policies, promoting the increasing privatization of water and irrigation processes. These policies had a significant impact on the irrigation sector in southern countries and often result in the transfer of the operations to Water User Associations [15]. Even in the WUAs, a sporadic representation of women is often observed [47]. This exclusion is usually due to the WUAs selection criteria, often allocated to the “formal rights holders” and based on the education level, on the social status and on the power relations within the local communities (which, in practice, exclude women) [48].

1.3. Water Gender Indicators

One of the main problems encountered in analyzing gender and water issues in agricultural contexts is the wide lack of available and uniform gender-disaggregated data, often highlighted by practitioners and academics [49,50] a deficit that may negatively influence the calculation and application of SMART (specific, measurable, achievable, relevant and time-bound) water gender indicators. However, even in the case of a larger availability of statistical information, data must be contextualized and critically detailed in order to adequately define the whole complexity behind gender relations and water management.

Hence, the difficulty to measure these dynamics and elaborate some gender sensitive indicators arises. Indicators are common tools for the lifetime because they summarize large amounts of data and give precise

information on the investigated topic. Gender indicators are even more critical because they require an accurate data gathering process disaggregated by sex. Moreover, they also capture many different aspects of women's and men's lives and reflect many gender issues. Some studies were carried out on water and gender indicators in agriculture [30,51,52].

One of the most remarkable attempts is represented by the work of Barbara Van Koppen, who proposed the Gender Performance Indicator for Irrigation (GPII). The GPII identifies intra-household divisions of farm labor and decision-making and access to land and water, and determines whether the decision-makers of a household's irrigated plots are women or men. The GPII further analyses the participation of women farm decision-makers within Water User Associations and their participation in leadership [30]. This latter point allows for stressing other important issues in the study of water and gender nexus: the possibility to become a member of such water associations is often connected to titles of land and water (generally owned by men). Since control over water resources and relative decisions generally results in political power, often rural women lack decision-making and voices within irrigation and water management organizations, contributing to rendering their active role in agriculture once again more invisible [17].

Another valuable attempt is represented by the Socio-economic and Gender Analysis (SEAGA) methodology, based on the analysis of socio-economic patterns and the participatory identification of the different gender needs at a rural level. The SEAGA was developed by the Food and Agriculture Organization (FAO), in partnership with the International Labor Organization (ILO), the World Bank (WB) and the United Nations Development Program (UNDP) in 1999. In particular, the SEAGA tool includes a Guide on Irrigation, aimed to include a more gender-oriented and participatory planning within the irrigation systems. An in depth space was dedicated to the women exclusion by the construction and

the maintenance operations [15], however without providing specific gender indicators.

The water gender indicators proposed in this study differ from the previous attempts: in this case, we underlined more the technical component (irrigation systems, type of used technology and fertilization system) applied to the specific context of horticulture. Furthermore, in this research, we did not focus on the households, but we considered three types of FOs (female, male and mixed) not only dedicated to irrigation purposes (as the GPII).

1.4. Research Questions

This work tries to partially answer the following question: is it possible to summarize and clearly show the whole described complexity through a simple system of indicators, directed to assessing and describing the gender (in) equalities in the water access, use and management in agriculture?

To achieve this goal, some fundamental sub-indicators referred to three types of farmer organizations (male, female, mixed) are proposed and analyzed, in order to facilitate their overall interpretation and application. The research background is a horticultural program carried out in some rural settings of three Senegalese regions. Since a joint management of drip irrigation systems is often fostered, it is interesting to analyze the correlations between this entrepreneurial model, the social capital (represented by the selected local FOs) and the gender implications. Other analyses have shown both the controversial [20,41,53] and the positive [54,55] effects of drip irrigation among small farmers in general, but without analyzing in depth the possible gender implications of such interventions among different types of FOs. Actually, even what may happen at the FO scale may positively or negatively affect the rural intervention. The overall idea behind the choice to compare three types of FOs (female, male and mixed) has been influenced by the conviction

that selecting only women (and women organizations) as the only beneficiaries of such development programs doesn't mean achieving the actual success and sustainability [43,44]. The micro-reality of the field is complex and multiple. For instance, looking at the context of the study, previous surveys clearly showed how, in the case of mixed FOs, generally women occupy only one position of responsibility on the total of six, which are generally accounted within such type of FOs [13].

In this work, some indicators are studied, in order to analyze the possible (social, economic, gender, ...) inequalities engendered by drip irrigation systems. The elaborated indicators may have several purposes. First, they can highlight the existent gender inequalities (in terms of access and management of resources first water and decision-power) between the different types of selected FOs. Second, they may allow the involved stakeholders both to better picture the initial situation in which the program is inserted and to better adapt the following future actions, in order to ensure a real, effective and sustainable participation of women within such water and agricultural programs.

The paper will be organized as follows. First, a synthetic description of the study area is provided. Afterwards, the specific methodology and the relative system of water gender indicators divided in five categories (social, plot, water, water technique, economic) are illustrated. Data for this study come from semi-structured questionnaires, submitted to a large sample (144 respondents) of local farmer organizations' representatives (women, men and mixed—both women and men) in three regions of Senegal (Thiès, Fatick and Diourbel). Therefore, the final results of the research are presented and critically discussed. Hereafter, the paper discussion is focused around the lack of gender-disaggregated data observed during the data gathering process, the possible ways to manage this type of problem and the implications of this gap in terms of Monitoring and Evaluation (M&E) and operationalization of the gender mainstreaming in practice.

2. Materials and Methods

Senegal has a long trajectory of development of farmer organizations at the rural level. Since the decolonization (occurred in 1960), the Senegalese State has directly promoted the FO development for the modernization of the rural world, starting from informal spontaneous groups (as the informal female groups for joint savings and credits schemes –called *tontines*) to more structured cooperatives, as the Women’s Promotion Groups (*Groupements de Promotion Féminine*—GPF—since 1968) and the Regional Rural Development Societies. In the early 1980s, following the structural adjustment reforms and the progressive disengagement of the central State, new endogenous associations, directly embedded within the villages (such as the *Groupements d’Intérêt Economique* —GIE), federations (national corporatist unions,) and federations of federations (such as the *Conseil National de Concertation et de Coopération des Ruraux* - CNCR) started to appear [42].

2.1. Research Context

Data were collected in the framework of a drip irrigation horticultural project started in 2013 and carried out in three regions of Senegal: Thiès, Fatick and Diourbel (Figure 1). According to the latest national households poverty survey, two of them (Thiès and Diourbel together with the Dakar region), accounted for almost half (48.6%) of the total population of Senegal and contributed more than 35% to the whole poverty rate of the country [56].

The project was aimed to improve the overall life, food security and production conditions of local small farmer organizations (women, men and mixed organizations) providing them with a more efficient irrigation method for the cultivated plots. The project presented since the beginning a gender sensitive lens since the main intended beneficiaries were women farmers. One component of the project was developed in

these central regions of Senegal (part of the so-called *Bassin Arachidier* and it was primarily focused on the improvement of the local horticultural production, for the final selection of 70 horticultural perimeters (each of them ranging from 5 to 10 hectares for a total of around 400 hectares) among the initial 144. A gender analysis of such horticultural component thus seemed the most interesting since, in Senegal, this sector (generally intended to export operations) mostly involves women even if especially as farm hands [57]. The project intended to apply a “communal system” of the cultivated land (in which the implication of farmer organizations is strongly fostered, as already mentioned before), using a common water source to irrigate all the plots of the horticultural perimeter. In practice, the whole perimeter was divided into individual plots, with several management committees (mainly composed of men) entitled to take decisions about the perimeter management.



Figure 1. The three studied regions.

Thiès, Diourbel and Fatick are regions next to the capital Dakar, provided with a quite efficient road system. The climate is semi-arid and the agriculture production is limited only to some products as mil (*Panicum Miliaceum* L.), sorghum (*Sorghum vulgare* L.), bean (*Vigna*

unguiculata L.) and peanut (*Arachis hypogaea* L.). In these areas, the reduction of the peanut prices (during the 1980s–1990s, also due to the devaluation of the West African CFA franc and the Central African CFA franc - CFA Franc), the climatic uncertainty and the soil degradation caused the decrease of incomes and the impoverishment of the rural population, producing a large emigration to Dakar and abroad [58,59]. In particular, two of the three considered regions (Fatick and Thiès) appear geographically and economically more advantaged (with access to the sea), while the third (Diourbel) is more inland, drought-stricken and not provided with an efficient road network.

The main sources of up-to date information related to these regions were deduced from the regional reports made by the National Statistic Agency of Senegal (*Agence Nationale de la Statistique et de la Démographie* - ANSD). However, such available gender disaggregated data were not completely uniform and harmonized, providing diverse types of information (for instance only limited to education, health or agriculture issues) for each analyzed region.

In these three regions, the heads of the agricultural households are mainly male, compared with a proportion of women varying between 13% and 15% (the same average than at the national level) [56].

The region of Thiès is an important centre of agricultural production due to its potential in water and soil characteristics. In 2009, the regional population was about 13% of the Senegalese population, with an equal distribution between women and men [60].

The population of the Fatick region, is young (as in the whole Senegal, where more than 50% of the population is under twenty years), while the sex ratio amounted to 98 men per 100 women [61].

In the Diourbel region, on the whole health situation, the 89% of the children recorded a good nutritional status compared to 65% in 2008, while, considering the prenatal consultations, around 45% of the pregnant women benefited from consultations [62].

A widespread water access deficit is present in the Fatick region, where only 9.5% of the population has a tap in the house (the national average at rural level is 18.3%) instead of the 38% of the other two regions. At the same time, another problem of water safety clearly appears in this region with 33.8% of unprotected wells (traditional open wells, where the risk of both water contamination—due to insects, animals excreta, dust, and people insecurity, e.g., children that may fall inside, is very high), against a national average of 25% [56].

Fatick is the more rural region (86% of the total population), whereas Diourbel is more urban-oriented (64% of the total population lives in the cities). In contrast, in the Thiès region, there is a more uniform distribution of the population between rural and urban areas (44.2%), but the region appears to be one of the main urbanized areas of the country [56]. On the basis of the main consulted statistical sources, the Diourbel region appears to be the most vulnerable by reasons of its deep deficiencies in terms of gender empowerment, especially with regard to access to education, agricultural inputs, socio-political representation and financial resources [63].

One of the main outcomes emerging from the study is the difficulty to find comparable gender disaggregated data at regional and local levels, especially those regarding the most economic issues referring to the agricultural activities and to the water use for productive purposes. Conversely, a good level of regional information on health, education and social issues disaggregated by gender can be observed.

2.2. Sample Description

A survey with a semi-structured questionnaire was conducted to interview 144 farmers organizations (of three types: women, men and mixed), each of them active in the horticultural sector. The questionnaires were conducted in 2015 and they were addressed to the representatives (generally the person in chief, e.g., the president or the

general secretary) of each FO. The sample was selected on the basis of the following criteria:

- A significant presence of women farmers;
- The presence of existing potential horticultural perimeters;
- The presence of local sources of water (suitable for horticulture activities) still active or to be rehabilitated;
- The presence of grassroots organizations already active in the area.

The three different types of FOs were not distinguished on the basis of their purpose and legal status (as economic, informal, cultural or village association). The informal associations represented around 25% of the total, while most of the selected FOs were Groups of Economic Interest GIE (40% of the total). This last feature can be well incorporated within the general approach followed by the drip irrigation interventions more oriented to the entrepreneurial management of the perimeters.

Most of the FOs (around the 50% of the total) were created in the 2000s, while one third in the 1990s and the remaining organizations during the 1970s and 1980s.

Interviews were carried out by researchers and technicians, with the presence of local facilitators.

The questionnaire was divided into three different sections (Table 1):

- Water sources;
- Horticultural perimeters;
- Grassroots organizations.

The first section (water sources) was aimed to identify type and status of the present water sources, mainly for agricultural purposes. The second part was intended to make an overview of the geographical position and the general characteristics of each agricultural perimeter. Finally, the third was designed to better understand the type of the farmer organizations active at local level, as well as their main activities and their level of internal governance.

Table 1. The collected data.

Questionnaire Section	Data and Unit	Type of Variable and Ranges
Water source	Type of source	nominal
	Type of pump	nominal
	Pump conditions	ordinal (broken = 0; functional = 1)
	Presence of reservoir	dummy (yes or not)
	Type of reservoir	nominal
	Quality of the water (for irrigation)	ordinal (not adequate = 0; adequate = 1)
	Water use (for domestic use or irrigation)	nominal
Horticultural perimeter	Plot distance from the village (meters)	continuous
	Size of the perimeter (hectares)	continuous
	Method of irrigation	nominal
	Perimeter status	ordinal (inactive = 0; active = 1)
	Average plots size	continuous
Grassroots organizations	Group legal status	nominal
	Group establishing (year)	discrete
	Sex of the Leader	dichotomy (man/woman)
	Group type	nominal (men's, women's or mixed)
	Number of men	discrete
	Number of women	discrete
	Gender of the secretary of water use association (if existing)	dichotomy (man/woman)
	Types of cultivated products	nominal
	Selling of products	dummy (yes/not)
	Purchase of inputs like fertilizer	dummy (yes/not)
	Joint cultivation of the perimeter	dummy (yes/not)
	Plots distribution (individual or group)	nominal
	Advantages of the membership	nominal

2.3. The Water Gender Indicators

On the basis of the main findings and constraints previously described in relation to water, gender and rural development issues, five macro-categories of indicators (social, plot, water, water technique, economic) have been proposed in order to critically analyze the results coming from the 144 questionnaires. Each macro-category included a set of sub-indicators (Table 2). In order to achieve a broader interpretation of the gender implications, these indicators were based on the necessity and the will to jointly include the multiple dimensions, more or less hidden, behind the water management issues [64,65].

Table 2. The categories of indicators and their sub-components.

Category	Sub-Components and Relative Codes		
<i>Social</i>	Age Class (AC)	First Education Level (EL)	Technical Training Access (TTA)
<i>Plot</i>	Plot Distance (PD)	Group Perimeter property (GPP)	Group Plot Distribution (GPD)
<i>Water</i>	Mixed Water Use (MWU)	Reservoir (R)	
<i>Water Technique</i>	Pump Presence (PP)	Improved Irrigation (II)	
<i>Economic</i>	Agricultural Products Selling (APS)	Fertilizers purchase (FP)	

Regarding the social category, the initial goal was to include data on age, education levels and access to technical training. This choice was designed to highlight the possible differences between women, men and mixed organizations. At the same time, the level of education is an important variable influencing the access to the main internal management positions, the knowledge of the necessary bureaucratic

procedures to achieve any financial support and the general degree of sustainability of horticultural and drip irrigation interventions [9], including better levels of food security and children protection. Another sphere in which most of the times women may be excluded is the provision of technical training and suitable extension services [34] actually designed to the specific requirements and limits of women active in agricultural contexts (e.g., lack of mobility, lower level of education, etc.).

It is largely shared by academics and practitioners how land is even one of the main constraints in terms of gender equality all around the world [66,67]. In this study, three specific variables connected to the horticultural plots were considered: plot distance (from the village), plot property (by the village or the group) and plot distribution (if individual or communitarian). Indeed, it is demonstrated that, when the plot is closer to the home (less than 500 m), generally women spend less time cultivating it and are more motivated. Some authors [68,69] showed also a strong connection between the distance of the water source from the household (and the related time dedicated to women and children to collect water) and its positive effects in terms of productivity, nutrition, health and general empowerment, especially if the water source (especially clean water) is located less than 1 km from the village.

Within the category “water”, we included the presence of a reservoir and the water uses (for domestic or production purposes). This latter aspect is particularly important since the different amounts dedicated to the water collection for other purposes (such as irrigation) than the domestic use is generally larger and it may subsequently create several competition problems [51].

Concerning the “water technique” category, this is generally one of the less analyzed aspects by researchers, despite its fundamental implications in terms of gender equality and project sustainability and accountability [70]. In this category, we inserted the presence of

mechanical systems of water lifting (such as pumps, etc.) or the presence of improved systems (as drip irrigation).

Finally, looking at the economic category, on the basis of the main constraints normally faced by women in agriculture [71,72], we focused the attention on two main collected variables: the capacity of the farmer organization to sell its agricultural products and the ability to carry out activities aimed to acquire productive inputs (such as fertilizers, etc.).

The five categories of proposed indicators cover different areas of the water management issues in horticulture. The proposed indicators are relatively easy to be periodically updated, as well as managed by practitioners and policymakers.

The purpose of the proposed indicators was to cover three main areas of analysis:

- Respondents characteristics (age, literacy rate, technical training level);
- Access to inputs (land, pumps, irrigation, fertilizers);
- Resources management (water use, products selling, method of perimeters allocation).

It is therefore possible to carry out a transversal analysis of collected data: on one hand, starting by each particular topic (plot, technique, water, etc.), as indicated in Table 2, and, on the other side, through a specific macro-area of study (see the previous bullet points).

This system of indicators has been applied to a specific project with peculiar characteristics and goals, but elaborating water gender indicators is an open and ongoing process that can be personalized according to the different purposes and applications of the involved stakeholders and apply also in other contexts.

2.4. Comparison among the Three Surveyed Groups (Women, Men and Mixed)

In order to have a complete picture of the indicators of the three types of FOs, as well as to compare them each other, we calculated a ratio. The ratio method seemed the more concise way to compare more than two groups. For each indicator, the ratios between the three surveyed groups (women, men, mixed) were calculated, in order to analyze how close or different they were among the farmer organizations types. Basically, the closer the ratio was to 1, the more the gender differences were not present.

In particular, four classes of water gender inequality were selected as follows:

- No inequality: $0.9 \leq \text{ratio} < 1.1$;
- Low inequality: $0.7 \leq \text{ratio} < 0.9$ or $1.1 \leq \text{ratio} < 1.3$;
- Medium inequality: $0.5 \leq \text{ratio} < 0.7$ or $1.3 \leq \text{ratio} < 1.5$;
- High inequality: $\text{ratio} < 0.5$ or $\text{ratio} \geq 1.5$.

3. Results

The survey involved: 19 men's organizations, 77 women's organizations and 48 mixed organizations. In particular, 75 farmers organizations were based in Thiès, 46 in Diourbel and 23 in Fatick, involving a total of about 4,800 individuals (56% women).

Each type of farmer organization had a different number of members (Table 3).

Table 3. Average number of members of the selected FOs.

FO Type	Average Number of Members	Standard Deviation	Max	Min
<i>Women</i>	67	41	200	10
<i>Men</i>	30	25	65	4
<i>Mixed</i>	31	41	320	2

In particular, the men’s organizations were generally smaller groups, while the women’s and mixed organizations were evidently more numerous groups. The mixed groups had an average of 20 men members and 45 women members. In the study sample, a good level of social capital and presence of women within the selected grassroots organizations can be observed. In particular, 50% of all of the involved organizations were women FOs, while around 50% of the organization leaders were women

3.1. Indicator Values

In Table 4, the percentages (as decimal number) of the respondents for each indicator composing the five macro-categories of analysis (e.g., social, plot, water, water technique, economic) are calculated.

Table 4. The indicators values, divided by women, men and mixed farmer organizations.

Category	Indicators	Organization (%)		
		Women	Men	Mixed
<i>Social</i>	15 < age < 65	n. a.	n. a.	n. a.
	At least I level education	n. a.	n. a.	n. a.
	Technical training	n. a.	n. a.	n. a.
<i>Plot</i>	Plot distance < 500 m (from the village)	0.58	0.92	0.59
	Group perimeter property (or village)	0.47	0.46	0.52
	Group plot distribution (not individual)	0.30	0.15	0.30
<i>Water Technique</i>	Pump presence	0.51	0.92	0.85
	Improved irrigation system (drip or other)	0.07	0.54	0.46
<i>Water</i>	Reservoir (to facilitate the irrigation)	0.53	0.69	0.57
	Mixed water use (domestic and irrigation)	0.74	0.69	0.67
<i>Economic</i>	Agricultural product selling	0.65	0.92	0.93
	Fertilizer purchase	0.58	0.85	0.89

Unfortunately, despite our desirable aim, from Table 4 it clearly emerges how, during the research, it was not possible to investigate the class age, the educational level and the access to previous training sessions of the sample because, as already mentioned, the proposed indicators were elaborated after the end of the questionnaires' submission and the social information was not directly included within such questionnaires.

Nonetheless, the unavailability of this type of social information and, thanks to the latest national statistical surveys, during the study, it was possible to extrapolate some key gender socio-economic data disaggregated at national and regional levels but not at the farmer organizations' scale.

Considering the education rates, in the three surveyed regions, women recorded a lower literacy rate (ranging from 23.9% of Diourbel to 43% of Thiès). Conversely, the literacy rate of men varied between about 55% (Diourbel) and 67.5% (Thiès) [73]. Another outcome concerned the different levels of input ownership fulfilled by Senegalese women, which appear, generally, poorly represented in the access to agricultural equipment: only 1.3% belong to women, compared with 98.7% for men. Moreover, women are slightly more present in joint-owned plots (5.2%) compared to 94.8% of men [74]. From the results analysis, it emerges how the women organizations appear the weakest, especially in relation to the water technique indicators, with a very low value regarding the improved irrigation systems (namely 7% against 54% of men and 46% of mixed). In addition, even the pumps system is present in only 51% of the surveyed women organizations, whereas this is almost always present within the men's organizations. The quite widespread absence of pumps within the women groups is generally translated into an increased workload and labor for women, and we are obliged to use buckets and/or watering cans to irrigate. On the other hand, women and men organizations show similar percentages on other water management issues: 53% of women have a reservoir against 69% of men, while the

water use (both for domestic and irrigation purposes) is performed by 74% of women organizations and 69% of men. Such values demonstrate that, when the resource water is used also for the household necessities, the gender differences between farmer organizations are lower. Other remarkable gender differences are recorded in the most economic indicators, accentuating the women organizations weaknesses even in the horticultural products selling (65% of women versus 92% of men) and in the fertilizer purchase (58% for women versus 85% for men) operations. Finally, considering the mixed organizations, their related percentages are more similar to those recorded for men organizations (Table 3), underlining lower differences between these two groups in the whole water management process.

3.2. Indicator Ratios and Comparison

In Table 5, the indicators ratios are calculated (between women and men organizations, women and mixed organizations and men and mixed organizations), including the formal codes attributed to each of them during the processing phase. Moreover, in Table 5, the different levels of equality/inequality between the observed FOs are shown through a scale of different colors.

Table 5. The ratios of the investigated indicators and the different levels of inequality between the observed FOs.

Category	Indicator	Code	Women/Men Ratio	Women/Mixed Ratio	Men/Mixed Ratio
Land	Plot distance < 500 m (from the village)	PD	0.63 ^a	0.98 ^b	1.56 ^c
	Group perimeter property (or village)	GPP	1.02 ^b	0.90 ^b	0.88 ^d
	Group plot distribution (not individual)	GPD	2.00 ^c	1.00 ^b	0.50 ^a
Water Technique	Pump presence	PP	0.55 ^a	0.60 ^a	1.08 ^b
	Improved irrigation system (drip or other)	IIS	0.13 ^c	0.15 ^c	1.17 ^d
Water	Reservoir (to facilitate the irrigation)	R	0.77 ^d	0.93 ^b	1.21
	Mixed water use (domestic and irrigation)	MWU	1.07 ^b	1.10 ^d	1.03 ^b
Economic	Agricultural products selling	APS	0.71 ^d	0.70 ^d	0.99 ^b
	Fertilizer purchase	FP	0.68 ^a	0.65 ^a	0.96 ^b

Legend: ^a = medium inequality; ^b = no inequality; ^c = high inequality; ^d = low inequality

Table 5 makes evident high disparities in many indicators between women and men organizations, while more likenesses exist between women and mixed organizations.

In particular, a high level of gender inequality concerns the water technique issues: in particular, the mechanical systems for the water lifting (pumps presence—PP) and the improved irrigation systems (ISS). In these two features, women organizations present evident shortages. Such lack may be explained by the possible diverse levels of capacities, training or attitudes between the different involved farmer organizations or rather by the presence of gender, socio and cultural bias (as noticed by some Ghana's researchers in a study of 2013) [29]. In this step of the research, only some suppositions can be made before pursuing with a more qualitative and specific analysis.

In addition, the plot distance (PD) is critical because women' plots are more distant from the village than men (as observed by Oxfam International and Save the Children [75]). The collective plot distribution (GPD) is more applied by women and mixed organizations. However, they unlikely have a water reservoir (R), which facilitate the irrigation. The agricultural product selling (APS) is generally more performed by men and mixed organizations, while the fertilizers purchase (FP) of women and mixed FOs is less

The plots' property (GPP) and the water use for domestic or irrigation purposes (MWU) do not represent a gender bias in these regions for the FOs.

Generally, we can observe a widespread inequality between the selected men and women FOs (Table 5), while women and mixed groups present more similar characteristics. This similarity may appear in contrast with another aspect that generally concerns the mixed groups. In this type of farmer organization, women often occupy a position of simple "agricultural workers", excluded by the internal decision institutions, in particular because of their lower level of

education (necessary even for the most basic secretary and treasury/financial tasks), but also due to their lack of negotiation and mobility skills (suitable for participating in training sessions, etc.) to compare with men. To confirm such gender inequality representation within the mixed organizations, when we look at the specific leadership of each type of FOs, we can delineate the following dynamics. In the case of women's organizations, the FO leader is usually a woman (with a proportion ranging from 60% to 100%), while, in the case of men's organizations, the leader is always a man (100%). Another notable outcome concerns the mixed groups where women leaders only represent 34%.

Additional data that may confirm such general situations on inequality is the average number of FO members (see Table 3). Generally, women's groups present a larger average of members (67 individuals), which cultivate and spread the benefits of smaller surfaces of land (Table 6).

In addition, 46% of men organizations own the bigger plots of land (greater than five hectares), while the same size of plots is cultivated by only 14% of the women groups (Table 6). On the contrary, about one third of the sample women organizations exploit the smallest plots of land (less than one hectare). The mixed groups presented an average situation, with 50% of cultivating plots including between one and five hectares.

Table 6 Average perimeter size of each type of FO

FO Type	Perimeter size (ha) and percentage on the total		
	Ha ≤ 1	1 < ha < 5	≥5 ha
<i>Women</i>	35%	51%	14%
<i>Men</i>	23%	31%	46%
<i>Mixed</i>	18%	46%	36%

In Figure 2, it is possible to appreciate the main equalities (data closer to 1 corresponding to no difference) and inequalities (data farther away from 1 corresponding to big differences) between women, men and mixed FOs.

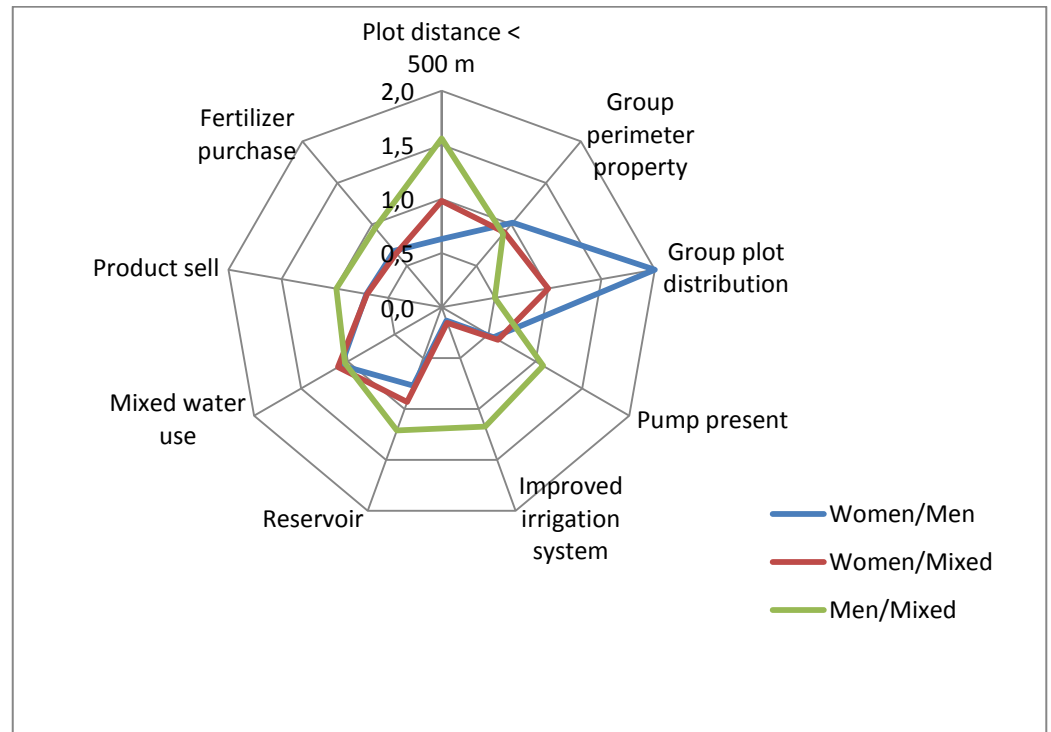


Figure 2. Indicators' ratio distribution.

In this figure, we especially highlighted the values of the plot distance from the village, where the women FOs appear very disadvantaged with respect to the men organizations. Furthermore, the same inequality between female and male FOs can be observed in relation to the technical solutions used to improve the plot irrigation methods (e.g., the presence of reservoirs, pumps and improved irrigation systems).

3.3 Gender issues within the local WUAs

With this regards, in the study we made an initial analysis aimed to study the gender component (e.g. the women participation and active presence) within the local Water User Associations (WUAs).

In Senegal, in the '80, the Senegalese government transferred the management responsibilities to the WUAs, even if maintaining the ownership rights of the water infrastructures. In the mid '90s the Senegalese government further enhanced the decentralization of the water management tasks by reinforcing the role of the WUAs and by fostering a greater private sector participation [76].

Despite Senegal has been frequently presented by some International Development Agencies [77,78] as a best practice in terms of private-public partnership for the water management system, many constrains can be observed, as the dependence on the scarce government funds for the renewal and maintenance operations and the weak governance, managerial and technical skills of the WUAs [79]. One of such limits, not enough considered by the mentioned literature, is the quite small space dedicate to the analysis of the gender component between the water management programmes and technical reports, which appear almost gender-blind.

If we look at the research sample, we can find the confirmation of the quite transparent role of women within such institutions (where they are largely present but without effective decision making power on access and management of resources, market etc.) as well as the generic lack of gender-sensitive data. Despite some problems of missing information (unfortunately the questionnaire presented 34 missing information on the whole sample of 61 water user associations) on the 27 WUAs which contain this information only three names of women appear, namely the 11.1% of the total. Accordingly it can be argued that this exclusion may negatively influence the final access of irrigation resources to women.

4. Discussion and Conclusions

One of the main purposes of the paper was to contribute to the debate around the new Sustainable Development Goals SDGs 5 and 6. Nonetheless, despite the progresses and the better openness shown by such SDGs, through more inclusive and differentiated decision-making processes [80,81] promoted by the international community, the distance between the official “discourses” and the field conditions is still far from being covered [82]. Indeed, one of the research outcomes is a critical discussion about the difficulties and the sensitive use of indicators, frequently observed in the field by researchers and practitioners in the M&E of water-related gender issues. The trend to rather focus the general efforts towards more suitable, efficient and sustainable solutions aiming to value existing data and surveys, instead of engaging new additional and “expensive” campaigns for the data gathering, is increasingly shared by academics and practitioners [83]. In this framework, the paper states that the use of easily attainable and understandable systems of water gender indicators, based on already existing databases, may allow (under certain circumstances such as the joint implementation of qualitative and participatory tools) not only to highlight the gender differences in terms of access, management and use of water for rural development purposes, but also to consequently better adapt the future and current projects’ implementation.

It has been clearly shown by researchers [84] how the same effects of drip irrigation projects may completely differ according to each geographical, institutional and socio-cultural background. For such reasons, it is clear that the results coming from the application of such systems of indicators may diverge according to different contexts. Thus, this case study should be mainly intended as a “user friendly” proposal to efficiently use available data in order to elaborate some SMART indicators on gender and water management issues in agriculture.

The main findings of the study proved and confirmed both the initial assumptions and the discussed literature about gender and water concerns in agriculture. In particular, the application of this system of water gender indicators to such sample of FOs allowed for delineating the following main gender features:

- 50% of all of the involved organizations were women FOs;
- the female leaders represented around the 50% of the total leaders;
- female and mixed organizations seemed more similar (but, at the same time, in the mixed groups, women leaders represented only one third of the total);
- the women's FOs were generally more numerous groups which cultivate smaller surfaces of land (one third of the women organizations exploited the smallest plots of land, less than one hectare);
- the women's plots were more distant from the village than those of the men;
- the women organizations appeared more weak in the product selling (65% of women versus 92% of men) and in the fertilizer purchase (58% for women versus 85% for men) operations;
- the women organizations presented very low values on the improved irrigation systems (namely, 7% against 54% of men and 46% of mixed);
- the water pumps were present in only 51% of the surveyed women organizations.

One of the limitations of this study is the limited scale of analysis of the research (three small regions of Senegal), while other previous studies were applied to a huge range of countries. Such criticism does not deliver a big comparative view but at the same time allows for highlighting several differences even existing at a very small scale.

From this study around indicators, the necessity clearly emerges to include a more widespread “social” dimension (with data as age, education, previous participation in technical training, etc.) since the beginning of the data gathering processes, the pre-implementation and the M&E phases of such rural development programs.

An additional interesting point to be developed in the future steps of the research is the inclusion, within the proposed system, of a sub-indicator on gender workload. Indeed, as already mentioned in relation to other types of technical projects, even in the case of drip irrigation interventions, the risk to affect the general position of the involved women is frequently noticed [41]. Conversely, in some cases [59], the application of drip irrigation systems may entail a generic decrease of the workload for all of the involved farmers, thus, perhaps, even for the women generally entitled to the manual watering operations. Unfortunately, during this phase of the study, it was not possible to calculate such workload sub-indicators because of the lack of suitable collected data. Indeed, the survey questionnaires were submitted before the implementation of the project activities in order to identify the main starting conditions of the selected FOs and of their horticulture perimeters.

Analyzing water access, distribution, and use in rural contexts implies studying governance issues—in particular “how decisions about water resources are made, by whom, at what geographical scales, and to whose benefit” [85] (p. 2). The same assumptions are valid in relation to the gender equality mechanisms. A suitable attention should be dedicated to the active and actual participation of women in the management committees of farmer organizations, in technical training and in water management associations. Real participation allows for dealing with the fair access of women farmers to the extension services for agriculture [86,87]. In addition, “an effective participation of women within technical and agricultural projects can strengthen both their

position and decision power within households and farmer and/or water management organizations, as well as improve the women's compliance with rules and maintenance problems" [48] (p. 337). At the same time, as observed by other researchers [88], an actual and equitable participation of the farmers (both women and men) within the irrigation process management generally generates greater levels of economic performance, energy saving and productivity. Many studies [45,46,89] emphasized the positive effects in terms of environmental and socio-economic sustainability due to collective actions managed by women. Important and effective consequences are strictly connected with the actual—not only as part of the "official machinery" [89] (p. 295)—application of the gender equality concepts in the development interventions. However, from the short analysis made to study the gender component within the local WUAs, the limited presence of women leaders within such intermediate organizations emerged. Thus, given the strong water dimension of the project, the potential changes in the water management group composition during the future implementation steps should be actively monitored, from a huge gender perspective. In order to achieve this goal and to better assess such women decision-power, the insertion of a specific WUA sub-indicator could be a suitable solution to improving the quality and the outreach of the whole system of the proposed water gender indicators.

Thanks to this study, we can see how making a gender-based analysis (through a system of water gender indicators) may allow to more deeply understand some more or less "hidden" water governance mechanisms and their related implications in terms of policy making [65]. The application of a suitable system of water gender indicators is important during the whole project stages, starting from the identification to the design, implementation and monitoring–evaluation steps. Indeed, a robust system of water gender indicators may allow a better and more efficient management of the agricultural interventions, by virtue of its

capacity to compare and jointly show the several dimensions connected to gender equality and water management issues. At the same time, this type of research should be jointly accompanied by rigorous qualitative and participatory surveys, in order to achieve a more in-depth overview of the complexity behind gender and water management issues within agricultural interventions. Thus, the next desirable steps of our study would be testing and joint and shared discussion about the potentialities and limits of such indicators with a significant representation of the sample organizations, following the criteria adopted by research in the action approach.

About the value of such water gender indicators, but also the need to be integrated with more participatory tools, some important points emerged from the research. First, the difficulty to find a good representation of women within the decision-making bodies of FOs, second the strong connection between gender data availability, effective participation, access to (water) resources, freedom to manage them and real representation and power of women within their communities. ,

Throughout this study, we have become more conscious of the limitations frequently addressed regarding the indicators as potential “tools of power and creation of knowledge” and expression of personal and subjective visions of the world [90]. For these reasons, in order to achieve an actual and concrete implementation of the above-mentioned SDGs in the field, we would also stress the need to ensure the gathering of real and effective “data for people by the people”, implying a greater ownership of such indicators by the target populations, even thanks to the inclusion of their personal perceptions, as stressed by many researchers [91], on the value and the potential of the water gender indicators.

Acknowledgments: This study was undertaken in the framework of the PAPSEN project, a project funded by the Italian Agency of Development

and Cooperation (AICS) and managed in cooperation with the Senegalese Ministry of Agriculture and the Israel's Centre for International Cooperation (MASHAW). The authors would like to thank the director and all the staff of the former Directorate General for Development Cooperation (DGCS), the directors and the staff of the Local Technical Unit (UTL) of Dakar, as well as the PAPSEN team, the Italian National Research Council (CNR), the ANSD and all the researchers and official representatives meet during the missions for their support and cooperation.

Author Contributions: Francesca Alice Centrone and Angela Calvo conceived and designed the whole study; Angela Calvo processed the data and analyzed them jointly with Francesca Alice Centrone; Angela Mosso and Patrizia Busato contributed to the analytical tools (specifically Angela Mosso on the economics and formal aspects of the paper, while Patrizia Busato regarding the irrigation and hydraulic components of the study) and provided useful advice on the draft manuscript; Francesca Alice Centrone mainly drafted the paper; all authors actively reviewed the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

ANSD	National Statistic Agency of Senegal
FAO	Food and Agriculture Organization
FOs	Farmer Organizations
GIE	Groupements d'Intérêt Economique
GPF	Groupements de Promotion Féminine
GPII	Gender Performance Indicator for Irrigation
IWMI	International Water Management Institute

MAER	Senegalese Ministry of Agriculture
M&E	Monitoring and Evaluation
SDGs	Sustainable Development Goals
SEAGA	Socio-economic and Gender Analysis
UN	United Nations
UNDP	United Nations Development Program
WB	World Bank
WUAs	Water User Associations

REFERENCES

1. United Nations Development Program (UNDP). UNDP policy and programme brief. In *UNDP Support to the Implementation of the 2030 Agenda for Sustainable Development*, United Nations Development Program (UNDP): New York, NY, USA, 2016.
2. Holden, E.; Linnerud, K.; Banister, D. The imperatives of sustainable development. *Sustain. Dev.* **2017**, *25*, 213–226, doi:10.1002/sd.1647.
3. Kumar, S.; Kumar, N.; Vivekadhish, S. Millennium development goals (MDGS) to sustainable development goals (SDGS): Addressing unfinished agenda and strengthening sustainable development and partnership. *Indian J. Community Med.* **2016**, *41*, doi:10.4103/0970-0218.170955.
4. Kabeer, N. Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1. *Gend. Dev.* **2005**, *13*, 13–24.
5. Van Koppen, B.; Hussain, I. Irrigation, Gender and Poverty: Overview of Issues and Options. In *Pro-poor Intervention Strategies in Irrigated Agriculture in Asia, Proceedings of the Regional Workshop and Policy Roundtable, Colombo, Sri Lanka, 25–27 August 2004*; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2004. Available online:

<https://core.ac.uk/download/pdf/6764857.pdf> (accessed on 23 April 2017).

6. Njuki, J.; Waithanji, E.; Sakwa, B.; Kariuki, J.; Mukewa, E.; Ngige, J. *Can Market-Based Approaches to Technology Development and Dissemination Benefit Women Smallholder Farmers? A Qualitative Assessment of Gender Dynamics in the Ownership, Purchase, and Use of Irrigation Pumps in Kenya and Tanzania*; IFPRI Discussion Paper 01357; International Food Policy Res Institute: Washington, DC, USA, 2014. Available online: <http://www.ifpri.org/publication/can-market-based-approaches-technology-development-and-dissemination-benefit-women> (accessed on 14 May 2017).
7. Freeman, H.A.; Silim, S.S. Commercialization of smallholder irrigation: The case of horticultural crops in semi-arid areas of eastern Kenya. In *Private Irrigation in Sub-Saharan Africa, Proceedings of the Regional Seminar on Private Sector Participation and Irrigation Expansion in Sub-Saharan Africa, Accra, Ghana, 22–26 October 2001*. Available online: <http://publications.iwmi.org/pdf/H030881.pdf> (accessed on 3 June 2017).
8. Upadhyay, B. Women and natural resource management: Illustrations from India and Nepal. *Nat. Res. Forum* **2005**, *29*, 224–232, doi:10.1111/j.1477-8947.2005.00132.x.
9. Jobbins, G.; Kalpakian, J.; Chriyaa, A.; Legrouri, A.; El Mzouri, E.H. To what end? Drip irrigation and the water-energy-food nexus in Morocco. *Int. J. Water Resour. Dev.* **2015**, *31*, 393–406, doi:10.1080/07900627.2015.1020146.
10. Wanvoeke, J.; Venot, J.P.; Zwarteveen, M.; de Fraiture, C. Performing the success of an innovation: the case of smallholder drip irrigation in Burkina Faso. *Water Int.* **2015**, *40*, 432–445,

doi:10.1080/02508060.2

015.1010364.

11. Karlberg, L.; de Vries, F.W.P. Exploring potentials and constraints of low-cost drip irrigation with saline water in sub-Saharan Africa. *Phys. Chem. Earth Parts A/B/C* **2004**, *29*, 1035–1042, doi:10.1016/j.pce.2004.08.004.
12. Woltering, L.; Pasternak, D.; Ndjeunga, J. The African market garden: The development of a low-pressure drip irrigation system for smallholders in the sudanosahel. *Irrig. Drain.* **2011**, *60*, 613–621, doi:10.1002/ird.610.
13. Robbiati, G.; Faye, A.; Ngom, Y.; Ngom, M.; Valori, F. Exploitations Horticoles Avec Irrigation Goutte-A-Goutte Dans le Bassin Arachidier. Available online: <https://documentslide.org/exploitations-horticoles-avec> (accessed on 8 December 2017).
14. Turrall, H.; Svendsen, M.; Faures, J.M. Investing in irrigation: reviewing the past and looking to the future. *Agric. Water Manag.* **2010**, *97*, 551–560, doi:10.1016/j.agwat.2009.07.012.
15. Food and Agriculture Organization. *SEAGA Sector Guide on Irrigation; Socio-Economic and Gender Analysis Program*: Rome, Italy, 2001. Available online: http://www.makeeverywomancount.org/images/stories/documents/FAO_SEAGASectorGuide-Irrigation_2001.pdf (accessed on 18 April 2017).
16. Buechler, S. Gendered vulnerabilities and grassroots adaptation initiatives in home gardens and small orchards in Northwest Mexico. *Ambio* **2016**, *45*, S322–S334, doi:10.1007/s13280-016-0832-3.

17. De Moraes, A.F.J. Advances and setbacks in women's participation in water management in Brazil. In *Political Ecology of Women, Water, and Global Environmental Change*; Buechler, S., Hanson, A.M., Eds.; Routledge: New York, NY, USA, 2015; pp. 77–97.
18. Buechler, S.; Sen, D.; Khandekar, N.; Scott, C.A. Re-Linking Governance of Energy with Livelihoods and Irrigation in Uttarakhand, India. *Water* **2016**, *8*, 437, doi:10.3390/w8100437.
19. Postel, S.; Polak, P.; Gonzales, F.; Keller, J. Drip irrigation for small farmers: A new initiative to alleviate hunger and poverty. *Water Int.* **2001**, *26*, 3–13, doi:10.1080/02508060108686882.
20. Van Koppen, B.; Hope, L.; Colenbrander, W. *Gender Aspects of Small-Scale Private Irrigation in Africa*; IWMI Working Paper 153; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2012.
21. Aladuwaka, S.; Momsen, J. Sustainable development, water resources management and women's empowerment: The Wanaraniya Water Project in Sri Lanka. *Gend. Dev.* **2010**, *18*, 43–58, doi:10.1080/13552071003600026.
22. Faurès, J.M.; Santini, G. *Water and the Rural Poor: Interventions for Improving Livelihoods in Sub-Saharan Africa*; International Fund for Agricultural Development (IFAD): Rome, Italy, 2008.
23. Kablan, M.K.A.; Dongo, K.; Coulibaly, M. Assessment of Social Vulnerability to Flood in Urban Côte d'Ivoire Using the MOVE Framework. *Water* **2017**, *9*, 292, doi:10.3390/w9040292.
24. Cleaver, F.; Elson, D. *Women and Water Resources: Continued Marginalization and New Policies*; Gatekeeper Series 49; International Institute for Environment and Development: London, UK, 1995; pp. 1–10. Available online:

<http://mekonginfo.org/assets/midocs/0003073-environment-women-and-water-resources-continued-marginalisation-and-new-policies.pdf> (accessed on 11 February 2017).

25. Green, C.; Baden, S. Integrated water resources management: A gender perspective. *IDS Bull.* **1995**, *26*, 92–100, doi:10.1111/j.1759-5436.1995.mp26001013.x.
26. Zwarteveen, M.Z. Water: From basic need to commodity: A discussion on gender and water rights in the context of irrigation. *World Dev.* **1997**, *25*, 1335–1349, doi:10.1016/S0305-750X(97)00032-6.
27. Moyo, R. Impact and Sustainability of Drip Irrigation Kits, in the Semi-Arid Lower Mzingwane Catchment, Limpopo Basin, Zimbabwe. Master's Thesis, University of Zimbabwe, Harare, Zimbabwe, 2005.
28. Buechler, S. Climate-water challenges and gendered adaptation strategies in Rayón, a riparian community in Sonora, Mexico. In *A Political Ecology of Women, Water and Global Environmental Change*; Buechler, S., Hanson, A.-M., Eds.; Routledge: New York, NY, USA, 2015; pp. 99–118.
29. Dittoh, S.; Awuni, J.A.; Akuriba, M. Small pumps and the poor: A field survey in the Upper East Region of Ghana. *Water Int.* **2013**, *38*, 449–464, doi:10.1080/02508060.2013.819454.
30. Van Koppen, B. *A Gender Performance Indicator for Irrigation: Concepts, Tools and Applications*; Research Report 59; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2002.
31. Van Houweling, E.; Hall, R.P.; Sakho Diop, A.; Davis, J.; Seiss, M. The role of productive water use in women's livelihoods: Evidence from rural Senegal. *Water Altern.* **2012**, *5*, 658–677.

32. Quisumbing, A. Male-female differences in agricultural productivity: Methodological issues and empirical evidence. *World Dev.* **1996**, *24*, 1579–1595, doi:10.1016/0305-750X(96)00059-9.
33. Quisumbing, M.A.R.; McClafferty, B.F. *Food Security in Practice: Using Gender Research in Development*, International Food Policy Res Institute: Washington, DC, USA, 2006.
34. Oseni, G.; Corral, P.; Goldstein, M.; Winters, P. Explaining gender differentials in agricultural production in Nigeria. *Agric. Econ.* **2015**, *46*, 285–310, doi:10.1111/agec.12166.
35. Hill, R.V.; Vigneri, M. Mainstreaming gender sensitivity in cash crop market supply chains. In *Gender in Agriculture: Closing the Knowledge Gap*; Quisumbing, A., Meinzen-Dick, R., Raney, T., Croppenstedt, A., Behrman, J., Peterman, A., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 315–341.
36. Doss, C.R.; Morris, M.L. How does gender affect the adoption of agricultural innovations? *Agric. Econ.* **2000**, *25*, 27–39, doi:10.1111/j.1574-0862.2001.tb00233.x.
37. Van Koppen, B.; Namara, R.; Safilios-Rothschild, C. *Reducing Poverty through Investments in Agricultural Water Management*, IWMI Working Paper 10; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2006. Available online: http://www.iwmi.cgiar.org/Publications/Working_Papers/working/WOR101.pdf (accessed on 9 April 2017).
38. Haile, A.M.; Depeweg, H.; Stillhardt, B. Smallholder Drip Irrigation Technology: Potentials and Constraints in the Highlands of Eritrea. *Mt. Res. Dev.* **2003**, *23*, 27–31, doi:10.1659/0276-4741(2003)023[0027:S
DIT]2.0.CO;2.
39. Upadhyay, B. Drip irrigation: An appropriate technology for women. *Approp. Technol.* **2003**, *30*, 31–33.

40. Harris, L.M.; Gantt, W. *Gender and Shifting Water Governance: Differential Effects of Privatization, Commodification, and Democratization*; Tenure Brief 6; University of Wisconsin: Wisconsin, DC, USA, 2007. Available online: <https://minds.wisconsin.edu/handle/1793/22157> (accessed on 6 March 2017).
41. Veldwisch, G.J.A.; Borsboom, V.; Ingen-Housz, F.J.M.; Zwarteveen, M.Z.; Post Uiterweer, N.C.; Hebinck, P.G.M. Low-cost drip irrigation in Zambia: Gendered practices of promotion and use. In *Drip Irrigation for Agriculture: Untold Stories of Efficiency, Innovation and Development*, Venot, J.P., Kuper, M., Zwarteveen, M., Eds.; Earthscan: New York, NY, USA, 2017; pp. 204–218.
42. Byerlee, D.; De Janvry, A.; Sadoulet, E. Agriculture for development: Toward a new paradigm. *Annu. Rev. Resour. Econ.* **2009**, *1*, 15–31, doi:10.1146/annurev.resource.050708.144239.
43. Agarwal, B. Gender and forest conservation: The impact of women's participation in community forest governance. *Ecol. Econ.* **2009**, *68*, 2785–2799, doi:10.1016/j.ecolecon.2009.04.025.
44. Agarwal, B. *Gender and Green Governance. The Political Economy of Women's Presence within and beyond Community Forestry*, Oxford University Press: Oxford, UK, 2010.
45. Van Koppen, B.; Hussain, I. Gender and irrigation: Overview of issues and options. *Irrig. Drain.* **2007**, *56*, 289–298, doi:10.1002/ird.296.
46. Wennink, B.; Nederlof, S.; Heemskerk, W. *Access of the Poor to Agricultural Services: The Role of Farmers' Organizations in Social Inclusion*; Bulletin 376; KIT Royal Tropical Institute: Amsterdam, Netherlands, 2008. Available online: http://www.kit.nl/sed/wp-content/uploads/publications/1287_Access-web-deell.pdf (accessed on 2 October 2017).

47. Van Koppen, B. Water rights, gender, and poverty alleviation. Inclusion and exclusion of women and men smallholders in public irrigation infrastructure development. *Agric. Hum. Values* **1998**, *15*, 361–374.
48. Meinzen-Dick, R.; Zwarteveen, M. Gendered participation in water management: Issues and illustrations from water users associations in South Asia. *Agric. Hum. Values* **1998**, *15*, 337–345.
49. Doss, C. Data needs for gender analysis in agriculture. In *Gender in Agriculture: Closing the Knowledge Gap*; Quisumbing, A., Meinzen-Dick, R., Raney, T., Croppenstedt, A., Behrman, J., Peterman, A., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 55–68.
50. Food and Agriculture Organization. *The State of Food and Agriculture. Women in Agriculture: Closing the Gender Gap for Development*; FAO: Rome, Italy, 2011. Available online: <http://www.fao.org/docrep/013/i2050e/i2050e.pdf> (accessed 9 February 2017).
51. Sullivan, C.A.; Meigh, J.R.; Giacomello, A.M. The water poverty index: Development and application at the community scale. *Nat. Resour. Forum* **2003**, *27*, 189–199, doi:10.1111/1477-8947.00054.
52. Seager, J. *Sex-Disaggregated Indicators for Water Assessment, Monitoring and Reporting*; Gender and Water Series; WWAP UNESCO: Paris, France, 2015. Available online: <http://unesdoc.unesco.org/images/0023/002340/234082e.pdf> (accessed on 20 May 2017).
53. Kalpakian, J.; Legrouri, A.; Ejekki, F.; Doudou, K.; Berrada, F.; Ouardaoui, A.; Kettani, D. Obstacles facing the diffusion of drip irrigation technology in the Middle Atlas region of Morocco. *Int. J. Environ. Stud.* **2014**, *71*, 63–75, doi:10.1080/00207233.2014.881956.

54. World Bank. *Reengaging in Agricultural Water Management. Challenges and Options*; World Bank: Washington, DC, USA, 2006. Available online: http://siteresources.worldbank.org/INTARD/Resources/DID_AWM.pdf (accessed on 1 October 2017).
55. Postel, S.L. Entering an era of water scarcity: the challenges ahead. *Ecol. Appl.* **2000**, *10*, 941–948, doi:10.1890/1051-0761(2000)010[0941:EAEOWS]2.0.CO;2.
56. Senegalese National Statistic Agency (ANSD). *Recensement Général de la Population et de l'Habitat, de L'Agriculture et de l'Elevage 2013. Rapport Définitif*; General Census Report 2013; Senegalese National Statistic Agency (ANSD): Dakar, Senegal, 2014. Available online: <http://www.ansd.sn/ressources/RGPHAE-2013/ressources/doc/pdf/2.pdf> (accessed on 10 January 2017).
57. Maertens, M.; Swinnen, J.F. Trade, standards, and poverty: Evidence from Senegal. *World Dev.* **2009**, *37*, 161–178, doi:10.1016/j.worlddev.2008.04.006.
58. Kelly, V.; Reardon, T.; Diagana, B.; Fall, A.A. Impacts of devaluation on Senegalese households: Policy implications. *Food Policy* **1995**, *20*, 299–313, doi:10.1016/0306-9192(95)00027-5.
59. Centrone, A.; Calvo, A. Dinamiche di genere nella gestione della crisi alimentare. Un'ipotesi di sviluppo dal basso nella filiera del riso lungo la Valle del fiume Senegal (Gender dynamics in the food crisis. A hypothesis of bottom-up approach in the rice supply chain along the Senegal River Valley). *Quaderni di Donne e Ricerca* **2014**, *35*, 1-56.
60. Senegalese National Statistic Agency (ANSD). *Situation Economique et Sociale de la Région de Thiès en 2009*; Economic and Social Situation of the Thiès Region in 2009; Senegalese National Statistic Agency: Dakar, Senegal, 2010. Available online:

http://www.ansd.sn/ressources/ses/SES_Thiès_2009.pdf (accessed on 11 December 2017).

61. Senegalese National Statistic Agency (ANSD). *Regional Statistics Service of Fatick, Situation Economique et Sociale de la Region de Fatick en 2008*; Economic and Social Situation of the Fatick Region in 2008; Senegalese National Statistic Agency (ANSD): Dakar, Senegal, 2009. Available online: http://www.ansd.sn/publications/annuelles/SES_Region/SES_Fatick_2008.pdf (accessed on 10 February 2017).

62. Senegalese National Statistic Agency (ANSD). *Regional Statistics Service of Diourbel, Situation Économique et Sociale de la Région de Diourbel en 2009*; Economic and Social Situation of the Diourbel Region in 2009; Senegalese National Statistic Agency (ANSD). Dakar, Senegal, 2010. Available online: http://www.ansd.sn/publications/annuelles/SES_Region/SES_Diourbel_2009.pdf (accessed on 10 February 2017).

63. Centrone, F.A.; Bock, B.B.; Mosso, A.; Calvo, A. The Role of Gender Indicators in Rural Development Programmes. In *Gender and Rural Globalization: International Perspectives on Gender and Rural Development*; Bock, B.B., Shortall, S., Eds.; Centre for Agriculture and Bioscience International: Wallingford, UK, 2017.

64. Molle, F.; Mollinga, P. Water poverty indicators: Conceptual problems and policy issues. *Water Policy* **2003**, *5*, 529–544.

65. Lu, F.; Ocampo-Raeder, C.; Crow, B. Equitable water governance: Future directions in the understanding and analysis of water inequities in the global South. *Water Int.* **2014**, *39*, doi:10.1080/02508060.2014.896540.

66. Lastarria-Cornhiel, S.; Behrman, J.A.; Meinzen-Dick, R.; Quisumbing, A.R. Gender equity and land: Toward secure and

effective access for rural women. In *Gender in Agriculture: Closing the Knowledge Gap*; Quisumbing, A., Meinzen-Dick, R., Raney, T., Croppenstedt, A., Behrman, J., Peterman, A., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 117–144.

67. Agarwal, B. Environmental action, gender equity and women's participation. *Dev. Chang.* **1997**, *28*, 1–44, doi: 10.1111/1467-7660.00033.

68. Pickering, A.J.; Davis, J. Freshwater availability and water fetching distance affect child health in sub-Saharan Africa. *Environ. Sci. Technol.* **2012**, *46*, 2391–2397, doi:10.1021/es203177v.

69. Graham, J.P.; Hirai, M.; Kim, S.S. An Analysis of water collection labor among women and children in 24 Sub-Saharan African countries. *PLoS ONE* **2016**, *11*, doi:10.1371/journal.pone.0155981.

70. Ray, I. Women, water, and development. *Annu. Rev. Environ. Resour.* **2007**, *32*, doi:10.1146/annurev.energy.32.041806.143704.

71. Meinzen-Dick, R.; Johnson, N.; Quisumbing, A.R.; Njuki, J.; Behrman, J.A.; Rubin, D.; Waithanji, E. The gender asset gap and its implications for agricultural and rural development. In *Gender in Agriculture: Closing the Knowledge Gap*; Quisumbing, A., Meinzen-Dick, R., Raney, T., Croppenstedt, A., Behrman, J., Peterman, A., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 91–115.

72. Boserup, E. *Woman's Role in Economic Development*; Routledge: Abingdon, UK, 2007.

73. Senegalese National Statistic Agency (ANSD). *Deuxième Enquête de Suivi de la Pauvreté au Sénégal en 2011*; Final Report of the Second Senegalese Poverty Survey; Senegalese National Statistic Agency (ANSD): Dakar, Senegal, 2013. Available online:

<http://anads.ansd.sn/index.php/catalog/17> (accessed on 19 May 2017). (In French)

74. Ministère de l'Agriculture et de l'Équipement Rural du Sénégal (MAER). *Rapport d'Analyse des Résultats de l'Enquête Agricole 2010–2011*; Agricultural Survey Report Analysis; Ministère de l'Agriculture et de l'Équipement Rural du Sénégal (MAER): Dakar, Senegal, 2012. Available online: http://www.au-senegal.com/IMG/pdf/rapport_de_pre_sentation_des_re_sultats_de_finitifs_de_la_campagne_agricole_2012–2013.pdf (accessed on 30 May 2017). (In French)

75. Hazard, E.; Troc, H.; Valette, D. Rising Food Prices in the Sahel: The urgency of long-term action. *Oxfam Policy Pract.* **2008**, *8*, 88–100.

76. Hanatani, A.; Fuse, K. Linking resource users' perceptions and collective action in commons management—an examination of water supply systems in Southern Senegal. *Water Policy* **2012**, *14*, 127–147, doi:10.2166/wp.2011.031.

77. United States Agency for International Development. Senegal Water and Sanitation Profile. March 2010. Available online: <http://www.washplus.org/sites/default/files/senegal2010.pdf> (accessed on 28 September 2017).

78. African Development Bank (AFD). *Senegal: Rural Water Supply and Sanitation Initiative Program Status*; African Development Bank (AFD): Abidjan, Cote d'Ivoire, 2015.

79. Diallo, O. *Levers of Change in Senegal's Rural Water Sector*; Water and Sanitation Program Report; World Bank: Washington, DC, USA, 2015.

80. Le Blanc, D. Towards integration at last? The sustainable development goals as a network of targets. *Sustain. Dev.* **2015**, *23*, 176–187, doi:10.1002/sd.1582.

81. Sachs, J.D. From millennium development goals to sustainable development goals. *Lancet* **2012**, *379*, 2206–2211, doi:10.1016/S0140-6736(12)60685-0.
82. Cornwall, A. Women's Empowerment: What Works? *J. Int. Dev.* **2016**, *28*, 342–359, doi:10.1002/jid.3210.
83. United Nations. A World that Counts. In *Mobilizing the Data Revolution for Sustainable Development*, The United Nations Secretary-General's Independent Expert Advisory: New York, NY, USA, 2014. <http://www.undatarevolution.org/wp-content/uploads/2014/12/A-World-That-Counts2.pdf> (accessed on 3 June 2017).
84. Van der Kooij, S.; Zwarteveen, M.; Boesveld, H.; Kuper, M. The efficiency of drip irrigation unpacked. *Agric. Water Manag.* **2013**, *123*, 103–110, doi:10.1016/j.agwat.2013.03.014.
85. Perreault, T. Custom and contradiction: Rural water governance and the politics of usos y costumbres in Bolivia's irrigators' movement. *Ann. Assoc. Am. Geogr.* **2008**, *98*, 834–854, doi:10.1080/00045600802013502.
86. Ragasa, C.; Berhane, G.; Tadesse, F.; Taffesse, A.S. Gender differences in access to extension services and agricultural productivity. *J. Agric. Educ. Ext.* **2013**, *19*, 437–468.
87. Peterman, A.; Behrman, J.A.; Quisumbing, A.R. A review of empirical evidence on gender differences in nonland agricultural inputs, technology, and services in developing countries. In *Gender in Agriculture: Closing the Knowledge Gap*; Quisumbing, A., Meinzen-Dick, R., Raney, T., Croppenstedt, A., Behrman, J., Peterman, A., Eds.; Springer: Dordrecht, The Netherlands, 2014; pp. 145–186.
88. Kosanlawit, S.; Soni, P.; Shivakoti, G.P. The Relationship between Effective and Equitable Water Allocation, Local Rice Farmer Participation and Economic Well-Being: Insights from

Thailand's Chiang Mai Province. *Water* **2017**, *9*, 319, doi:10.3390/w9050319.

89. Arora-Jonsson, S. Forty years of gender research and environmental policy: Where do we stand? *Women's Stud. Int. Forum* **2014**, *47*, 295–308.

90. Merry, S.E.; Conley, J.M. Measuring the world: Indicators, human rights, and global governance. *Curr. Anthropol.* **2011**, *52*, S83–S95.

91. Njuki, J.; Mapila, M.; Kaaria, S.; Magombo, T. Using community indicators for evaluating research and development programs: Experiences from Malawi. *Dev. Pract.* **2008**, *18*, 633–642, doi:10.1080/09614520802181913.

© 2017 by the authors. Submitted for possible open access publication



under

the

terms and conditions of the Creative Commons

Attribution

(CC

BY)

license

(<http://creativecommons.org/licenses/by/4.0/>).

5. QUESTIONS DE GENRE ET DEVELOPPEMENT DURABLE: LE POTENTIEL DE L'AGROECOLOGIE DANS LE NORDESTE DU PARÁ

Centrone Francesca Alice¹, Tonneau Jean Philippe², Piraux Marc²; Cialdella Nathalie³, De Sousa Leite Tania ⁴, Mosso Angela.⁵, Calvo Angela¹

1. *Département de Sciences Agricoles, Agro-alimentaires et des Forêts (DISAFA), Université de Turin, Grugliasco (TO), Italie. Centre Interdisciplinaire de Recherche et Etudes sur les Femmes et le Genre (CIRSDe), Centre Interdépartemental de Recherche et Coopération Scientifique et Technique avec les Pays du Sahel et de l'Afrique de l'Ouest (C.I.S.A.O.), Université de Turin, Turin, Italie.*

2. *CIRAD, UMR TETIS, F-34398 Montpellier, France. TETIS, Univ Montpellier, AgroParisTech, CIRAD, CNRS, IRSTEA, Montpellier, France.*

3. *CIRAD, UMR INNOVATION, F-34398 Montpellier, France. INNOVATION, Univ Montpellier, CIRAD, INRA, Montpellier SupAgro, Montpellier, France.*

4. *Université Fédérale du Pará. Belém. Brésil.*

5. *Département de Sciences Agricoles, Agro-alimentaires et des Forêts (DISAFA), Université de Turin, Grugliasco (TO), Italie.*

COPYRIGH. This paper has been submitted to *Cahiers Agricultures* on January, 18, 2018 and currently it is under revision.

Résumé

L'agriculture mondiale est confrontée à de nombreux défis en termes de souveraineté alimentaire et de développement durable. L'agroécologie semble être l'une des options les plus appropriées pour atteindre ces objectifs, en raison de son caractère holistique, dans des processus qui favorisent des modèles de production et de consommation alimentaire

plus sains, plus inclusifs socialement et plus respectueux des ressources naturelles. L'agroécologie promeut aussi des relations sociales plus égalitaires, en particulier entre hommes et femmes. Pourtant, les relations et les implications entre l'agroécologie et les questions de genre restent encore une question peu explorées. L'objectif de cet article est de mettre en évidence et d'analyser de manière critique les principales opportunités et contraintes de l'agroécologie en termes d'égalité des sexes et par là de contributions au développement durable. La recherche a été réalisée dans le cadre d'expériences agroécologiques menées dans le Nord-est de l'Amazonie brésilienne, où les agricultrices pratiquent principalement l'extractivisme et où l'agroécologie est encore dans une phase d'émergence si on la compare avec d'autres régions du pays. Dans ces expériences, malgré leur faible reconnaissance et leur accès limité aux ressources, les femmes contribuent activement à la conservation de la biodiversité et au transfert des connaissances traditionnelles. Mais l'analyse détaillée de l'impact des expériences agroécologiques en termes d'égalité de genre reste à faire. Néanmoins des mesures sont proposées pour optimiser les interactions entre agroécologie et égalité des genres. L'égalité de genre et la valorisation du travail des femmes pourraient être des critères des labels agroécologiques. Un autre chantier est celui de la pérennité et de la continuité des actions. Cette question pose en filigrane la question des politiques publiques et de leurs orientations.

Mots clés: agroécologie ; égalité de genre ; Brésil; développement durable

GENDER ISSUES AND SUSTAINABLE DEVELOPMENT: THE POTENTIAL OF AGRO-ECOLOGY IN THE NORTH-EAST OF PARA'.

Abstract

World agriculture is facing many challenges in terms of food sovereignty and sustainable development. The agro-ecological approach seems one

of the most suitable option to achieve such goals, because of its holistic nature promoting production systems and food consumption models more healthy, socially inclusive and respectful of natural resources. In addition, agro-ecology is designed to support more egalitarian social relations, such as those related to gender equality. Nonetheless, the analysis of the relations and the implications between agroecology and gender issues is still a quite unexplored issue. Therefore, the aim of this article is to critically analyse and highlight the main opportunities and constraints of agroecology in terms of gender equality and thus contribution to sustainable development as well. The research was realized within some agroecological experiences carried out in the North east of the Brazilian Amazonia, where women farmers work mostly in the extractive agriculture and where agroecology is still in a preliminary phase to compare with other regions of the country. In the research context, despite their scarce acknowledgment and access to resources, local women actively contribute to the biodiversity conservation and the transfer of traditional knowledge. However the detailed analysis of the impact of agroecological experiences in terms of gender equality remains to be performed yet. Nevertheless, some measures are proposed in order to enhance the interactions between agro-ecology and gender equality. Gender equality and the valuing of women's work could become fundamental criteria for the assignment of agroecological labels. Another feature is related to the sustainability and continuity of actions, a question raising the issue of public policies and their orientations.

Key words: agroecology; gender equality; Brazil; sustainable development

5.1 Introduction

Les Objectifs du Développement Durable (ODD) ont été adoptés par l'ONU en septembre 2015. L'Objectif 5 fait spécifiquement référence à l'égalité des sexes et à l'autonomie des femmes. Mais ces deux

thématiques sont transversales à tous les autres objectifs, car la mise en œuvre du DD passe nécessairement par elles.

En fait, dans l'agriculture comme ailleurs, les femmes font face à d'importantes contraintes en termes d'accès, de gestion et de maîtrise réelle des ressources tangibles (terre, crédit, intrants, technologie, etc.) et intangibles (services de vulgarisation, formations techniques, innovation, etc.) (Quisumbing et Pandolfelli, 2010, Cornwall 2016). Les femmes disposent de peu de pouvoirs de décision et peinent à faire reconnaître leurs spécificités, par exemple leur plus grande charge de travail (Meinzen-Dick et al., 2014).

Par ailleurs, l'agroécologie est aussi considérée comme un objectif et un moyen pour atteindre les ODD. L'agroécologie est présentée tout d'abord comme un ensemble de bonnes pratiques pour le développement durable (Altieri, 2002; FAO, 2011; Tonneau et Teixeira, 2002). Gender et agroécologie couvrent donc des finalités communes. La question de leurs articulations se pose. Nobre (2005) a montré notamment que les choix des femmes pour des pratiques agroécologiques ne sont pas seulement des choix écologiques. C'est aussi un moyen d'éviter les mécanismes d'exclusion technologique dus au faible accès des femmes aux services de vulgarisation et à l'assistance technique, porteuse de la «révolution verte» (Shiva, 1997). Mais lorsque les exploitations agroécologiques atteignent de meilleurs niveaux de performance, les hommes redeviennent les protagonistes des prises de décision (Prevost et al., 2014; Siliprandi, 2015).

En conséquence, les questions qui structurent notre réflexion sont les suivantes: l'égalité des sexes consolide-t-elle l'agroécologie ? L'agroécologie favorise-t-elle l'égalité des sexes ? L'agroécologie permet-elle de lever les contraintes que les femmes subissent en termes d'accès, de gestion et de maîtrise réelle des ressources nécessaires à l'activité agricole? Et enfin comment peut-on rendre visible, mesurer et évaluer ces processus ?

Par ailleurs l'agroécologie est aussi un modèle de développement alternatif basé sur une forte reconnaissance des connaissances, des compétences et des expériences détenues par les populations locales. En ce sens, l'agroécologie est représentative d'un monde parfois présenté comme "masculin", (Rosset et al., 2011; Amekawa, 2010) car basé sur la division traditionnelle du travail agricole (Prévost et al., 2014) et sur des dominations ancrées dans le temps.

Au Brésil, l'agroécologie a été reconnue par le gouvernement fédéral. Des politiques ad-hoc ont été mobilisées pour assurer son développement. Mais dans le même temps, comme ailleurs (Boserup et Kanji, 2007 ; Sachs, 1996), les femmes ne sont pas toujours réellement perçues comme de "vrais agriculteurs", et leur contribution reste peu visible dans les statistiques officielles, même si des politiques publiques spécifiques leurs sont dévolues, comme le crédit rural. La FAO indiquait que 13% de agriculteurs étaient des agricultrices au Brésil, alors que Butto et Dantas (2011) évaluaient à 50% le taux des femmes actives dans la production autoconsommée et à 65% le taux des femmes travaillant sans rémunération notamment dans l'horticulture, la sylviculture et l'élevage de petits animaux. Cette invisibilité des femmes agricultrices dans les statistiques et dans les enquêtes agricoles officielles influencent les orientations des politiques publiques. Dans ces conditions, le débat est croissant autour du lien entre l'agroécologie et l'égalité de genre (Lima et De Jesus, 2017).

Nos recherches ont été menées en Amazonie, dans le Nordeste du Pará, dans le municípe de Santa Luzia et à Belém, la capitale régionale, dans le cadre du dispositif en partenariat « Amazonie » réunissant l'UFPA (*Universidade Federal do Pará*), l'Embrapa (*Empresa Brasileira de Pesquisa Agropecuária*) de Belém et le CIRAD. Le réseau « *Rede Bragantina de Economia Solidaria* » a facilité la logistique et les contacts. Ce réseau regroupe des associations de communautés quilombolas, une coopérative de producteurs (*Cooperativa Mista dos*

Agricultores entre os Rios Caete e Gurupi – COOMAR), avec 50 membres actifs (dont 10 femmes), une association féminine (*Associação da Mulher Luziense Olímpia da Luz, AMOL*), une école ECRAMA (*Escola de Formação Para Jovens Agricultores de Comunidades Rurais Amazônica*) et une association d'appui en apiculture et production de miel.

Nous avons réalisé 17 entretiens individuels et nous avons animé 4 sessions participatives de focus groupe avec des producteurs et des productrices en agroécologie ou en agriculture organique, des représentants des organisations de producteurs et de structures d'appui (coopérative et associations), des membres des ONG et des associations féminines, des chercheurs (Universités et institutions de recherche), des politiques (échelons national et local, municipale de Santa Luzia) et des syndicalistes.

Les entretiens et les rencontres ont approfondi les hypothèses suivantes. La première hypothèse est qu'au niveau local, l'inégalité des sexes a pour origine les représentations qu'ont les acteurs sur le rôle des hommes et des femmes. Ces représentations se traduisent par des situations d'inégalités à la fois dans la prise de décisions et dans l'accès à l'éducation, aux fonctions politiques et décisionnelles, à la terre, au crédit et à l'assistance technique. C'est la deuxième hypothèse. La troisième hypothèse est que les actions du mouvement agroécologique contribuent à réduire ces inégalités de genres.

Les travaux à Santa Luzia avaient pour objectifs de caractériser les rapports de genre dans les différents systèmes de production. Les activités à Belém voulaient étudier principalement les relations avec les consommateurs de produits agroécologiques et recueillir les témoignages des représentants des institutions.

La structuration de l'article reprend les thèmes abordés lors des entretiens. Après avoir présenté rapidement le municipale de Santa Luzia, nous aborderons successivement les représentations sur les femmes

dans l'agroécologie, les contraintes qu'elles rencontrent, les actions menées par le mouvement agroécologique et leurs impacts. En conclusion, nous faisons des recommandations pour améliorer l'efficacité des actions du mouvement en faveur des femmes.

5.2 Le Nordeste Paraense et la commune de Santa Luzia

Le territoire du Nordeste-Paraense est composé de 20 municipalités avec une population totale de 734.545 habitants, dont 48% vivant dans les zones rurales. Le municipe de Santa Luzia do Pará (Figure 1) se positionne à environ 200 km à l'est de Belém, dans la microrégion Guamã. Il est traversé par la route fédérale BR-316 qui connecte Belém à Brasilia. Il s'étend sur une surface de 1.356 km², avec une population de 19,348 habitants (2016) pour une densité de 14.27 hab./km². La commune a été créée récemment, en 1991 (FAPESPA, 2016).



Figure 1. Localisation de Santa Luzia do Pará

Du fait de l'exode rural, la population rurale est passée de 60% en 2000 à 46% en 2010 (*ibid.*). Les activités sont agricoles et extractivistes. Les activités extractivistes concernent le bois et l'utilisation des produits de la forêt. Le municipe compte des communautés de quilombolas (créés par les esclaves marrons fugitifs) et quelques communautés indigènes. Ces communautés se caractérisent par la grande connaissance qu'ont les populations de la nature et de ses ressources. Dans ces conditions,

nous avons considéré que les systèmes agricoles et extractivistes relevaient de l'agroécologie.

Par ailleurs, l'agriculture est une agriculture diversifiée avec une cohabitation entre les entreprises agricoles, principalement d'élevage (fazendas) et l'agriculture familiale plus diversifiée (manioc, banane,...).

5.3 Les représentations locales de l'agroécologie : la femme toujours vouée à l'économie domestique ?

Les représentations locales concernant l'agroécologie sont très différentes. Il en est de même pour le statut et le rôle des femmes.

5.3.1 Des représentations différentes de l'agroécologie

Pour la totalité des acteurs enquêtés l'agroécologie se caractérise par la non-utilisation de pesticides. Mais selon les protagonistes, d'autres caractéristiques sont mises en avant. Certains vont souligner le caractère politique de l'agroécologie, mouvement de transformation sociale. D'autres vont insister sur l'impact économique. L'agroécologie permet de mieux vendre en produisant des produits de qualité et en instituant des réseaux de confiance avec les acheteurs. D'autres encore louent les bénéfices en termes de santé, liées à la production d'une alimentation saine.

Ces différents regards montrent que l'agroécologie est traversée par les tensions et les débats habituels sur les équilibres à trouver entre les différents piliers du développement durable. S'il y a un consensus sur le respect de l'environnement, le pilier économique peut dominer le pilier social, l'insertion au marché sur la solidarité....

La dimension politique de l'agroécologie est davantage présente chez les acteurs institutionnels et les responsables des associations, des militants, se voulant porteurs d'un projet de société. Les producteurs de base quant à eux, soulignent surtout les aspects agricole et environnemental.

Cette distinction de représentation entre acteurs institutionnels et producteurs de base est plus significative que les différences entre sexes. Femmes et hommes, d'un même type d'acteurs, tiennent des discours proches sur l'agroécologie. Ainsi, les présidentes des associations, membres du réseau Bragantina, défendent le caractère politique de l'agroécologie. Par contre, cette dimension politique est généralement peu affirmée chez les producteurs et productrices, vendeurs et vendeuses au marché de Bélem. Ils et elles se présentent comme de « vrais entrepreneurs et entrepreneuses » agricoles, principalement préoccupés de la durabilité économique de leurs activités. Mettant en avant leurs pratiques agricoles, ils et elles préfèrent d'ailleurs utiliser plus souvent le terme agriculture organique.

Ces divergences se retrouvent dans les activités menées avec Natura, une entreprise multinationale brésilienne de production de cosmétiques et produits d'hygiène et de santé d'origine naturelle. Les femmes des communautés quilombolas de Santa Luzia do Pará et du Movimento de Mulheres das Ilhas de Bélem (MMIB Cotijuba) collectent la semence de *murumuru* (*Astrocaryum murumuru*) pour cette entreprise. Le beurre de *murumuru*, extrait des graines de la plante, est utilisé comme hydratant. L'intérêt de travailler avec une multinationale comme Natura fait débat au sein des communautés. Pour certains, la coopération avec Natura risque de se traduire par un abandon des valeurs initiales de l'agroécologie et de favoriser un « mauvais » développement. Le débat entre insertion dans les circuits de la commercialisation et projet alternatif oppose surtout les producteurs et productrices qui ont réussi, aux responsables des associations. Les autres producteurs et productrices restent assez étrangers à ce débat.

Le même décalage se retrouve quand les entretiens abordent les thèmes du développement durable. Le discours des responsables des associations reprend les enjeux de l'agenda international. Mais ce discours peine à intégrer des réponses concrètes aux questions

sociales, à la pauvreté, à l'accès au marché et aux droits élémentaires, questions que vivent les producteurs de base.

5.4 Femmes et agroécologie

Dans tous les entretiens, le lien fort entre les femmes et la dimension environnementale de l'agroécologie est mis en avant.

Les femmes sont les victimes principales des effets négatifs des changements climatiques et de la déforestation, du fait notamment de leur mobilité plus faible (*« ici dans l'Amazonie les hommes migrent, se déplacent davantage pour aller cultiver et travailler ailleurs... tandis que les femmes restent à la maison »*).

Plusieurs réponses mettent l'accent sur l'attitude différente des hommes et femmes face à la nature, au travail et par conséquent aux techniques productives. *« Les hommes ont une interprétation technique »* et très transformatrice *« ... si quelque chose ne marche pas, il faut changer... tandis que la femme est plus constante, patiente, avec plusieurs interprétations, plus ouverte et flexibles aux changements et aux innovations... »*. Ceci expliquerait que les femmes pratiquent plus l'agroécologie qui nécessite du temps et de la patience.

Mais la principale raison, à notre avis, est probablement que les rôles politiques et économiques des activités des femmes ne sont pas reconnus. Les femmes sont très peu présentes dans les instances de décision que ce soit dans les exécutifs et les législatifs municipaux, les instituts techniques ou dans les associations, sauf celles uniquement féminines. Le manque de reconnaissance concerne aussi la gestion des exploitations. Ainsi, malgré son succès économique en qualité d'entrepreneuse, une veuve expose ses difficultés à être considérée comme la chef de l'exploitation, à interagir et donc à donner des ordres aux ouvriers hommes travaillant pour elle.

La valeur des activités productives des femmes est peu prise en compte. L'« agroécologie des femmes », celle liée aux jardins familiaux

et à la collecte de plantes médicinales, n'est pas reconnue comme une activité motrice de l'économie des ménages. Les femmes sont d'ailleurs souvent les premières à ne pas mesurer, évaluer à ne pas valoriser, voir pour certaines à dévaloriser leurs contributions à l'économie familiale. Elles mettent en place une éducation différenciée des enfants (filles et garçons). Elles critiquent souvent les femmes pionnières: « *nous ne donnons pas de la valeur au travail de nos femmes...Pour changer..., nous devons partir des comportements machistes présents dans nos familles!* ». Les femmes sont également reconnues comme porteuses de la sauvegarde de la biodiversité. Selon les entretiens menés avec les femmes, les hommes ne disposeraient pas de ces connaissances « *moi, je cultivais une plante sur notre terrain, plante dont ma mamie m'avait parlé, mais mon mari ne la connaissait pas et l'a coupée!* ». Ces connaissances sont transmises de génération en génération, notamment de mère à fille et nièce. Toutes les femmes rencontrées, même celles qui ne sont pas directement productrices, peuvent reconnaître, collecter et utiliser un grand nombre de variétés différentes d'arbres, de plantes, d'herbes, de fruits et de semences. Elles ont aussi les compétences nécessaires pour préparer les médicaments traditionnels à base de produits de la forêt.

A noter que les communautés quilombolas, d'origine africaine, donnent plus d'espace et de pouvoir aux femmes, plus que dans les communautés indigènes et bien plus encore que dans l'agriculture familiale.

5.5 Contraintes spécifiques liées aux femmes et à l'agroécologie

Cette représentation mitigée du rôle de la femme dans l'agroécologie perpétue les fortes contraintes en termes de production. Quatre inégalités sont habituellement identifiées par la littérature (Milgroom,

2015): l'accès à la terre, aux intrants, au crédit, à l'éducation et aux services de vulgarisation.

A Santa Luzia, la principale contrainte citée dans les entretiens est celle liée aux services de vulgarisation et d'appui. Les femmes formateurs/agents sont en nombre dérisoire. Au niveau national, 30% des employés de l'ATER sont des femmes. Mais elles sont surtout en charge du domaine social, les employés hommes s'occupant des tâches techniques et d'ingénierie (Ferro, 2014). Les femmes agricultrices ne sont que très rarement les bénéficiaires de formations spécifiques. Les vulgarisateurs, même dans le cadre du PRONAF (*Programa Nacional de Fortalecimento da Agricultura Familiar*), *Mulher* (une mesure de crédit pensée expressément pour les femmes) suggèrent, de façon plus ou moins implicite aux femmes d'effectuer des choix productifs et des demandes de crédits « *complémentaires à ce que font leur maris !* ». De nombreux auteurs ont souligné que la notion de complémentarité cachait souvent le refus de l'égalité (Rieu et Dahache, 2008). A ce titre, la discrimination semble exister pour le crédit agricole. Dans le cadre du programme PRONAF la femme mariée ne peut pas demander un crédit sans se présenter conjointement avec son mari.

Il n'y a pas de discriminations évidentes entre hommes et femmes par rapport aux droits de succession de la terre. Les différenciations sociales sont ici plus importantes que les inégalités entre sexe. De nombreuses femmes sont « propriétaires » de la terre héritée de leurs parents. Mais, comme les hommes, elles ne disposent pas toujours des titres de propriété leur permettant d'avoir accès plus facilement aux financements institutionnels.

5.6 Les actions du mouvement de l'agroécologie pour lever les contraintes.

La participation des agricultrices aux luttes sociales rurales et aux expériences du mouvement agroécologique est très ancienne au Brésil. Cependant le rôle des femmes rurales au sein des mouvements sociaux brésiliens n'a été reconnu formellement qu'à partir des années '80. La création d'associations spécifiques de travailleuses rurales s'est structurée au cours de la décennie 1990. A noter que l'organisation des mouvements féminins ruraux a été plus tardive en Amazonie que dans le Sud ou le Nordeste du Brésil. Dans la même période, les communautés quilombolas se sont mieux organisées et de façon plus systématique (Siliprandi, 2015).

En Amazonie, et dans le Pará, pour faire face aux contraintes décrites auparavant (comme le manque de formation et d'assistance publique etc.), plusieurs réseaux souvent uniquement féminins ont été créés à partir des années 2000. Les femmes y occupent des positions de premier plan, comme dans la Rede Bragantina.

Le but principal des réseaux est de favoriser les échanges de connaissances et le renforcement de compétences principalement autour des produits et pratiques agricoles. Mais d'autres thèmes sont abordés comme la certification sociale participative. Les thématiques de contrôle de la qualité et de la sécurité alimentaire des produits sont y aussi présentes. *«Avant pour l'huile de coco, j'utilisais n'importe pas quel type de bouteille pour le garder, maintenant, après la formation, j'utilise des bouteilles foncées»*). Les réseaux contribuent aussi à la construction de relation de confiance par la connaissance personnelle entre vendeur et acheteur. La mise en réseau renforce aussi un sentiment d'appartenance commune autour d'un logo spécifique, en donnant plus de valeur (même symbolique) et de conscientisation aux femmes impliquées. L'artisanat, la sécurité sur le travail, la gestion

environnementale, la commercialisation de produits et l'utilisation des technologies de l'information et de la communication (TICs) sont aussi thèmes de formation. «*Je cultive comme ma grand-mère mais j'utilise WhatsApp pour recevoir les commandes* ». Les formations permettent aussi d'aborder les droits individuels et la violence domestique. Les formations s'adressent aussi aux jeunes, afin de limiter leur exode rural. C'est notamment l'objectif de l'école Ecrama) où les élèves sont des jeunes de moins de 25 ans, avec une légère prédominance de garçons. C'est aussi l'objectif des écoles des quilombolas où la maîtresse est généralement une jeune femme issue de la communauté.

5.7 Impacts des actions du mouvement agroécologique pour les femmes

Lorsqu'on étudie les effets des programmes de développement écologique sur les femmes, de nombreux critères doivent être pris en compte. Leach (2007) montre que dans les années '90, le «succès» des projets a souvent été obtenu aux dépens des femmes, en mobilisant leur travail, non rémunéré, dans des activités qui souvent ne répondaient pas à leurs besoins ou dont elles ne contrôlaient pas les bénéfices. Ces projets ont ajouté de nouvelles tâches à la longue liste de rôles « bénévoles » des femmes.

Par ailleurs, les organisations féminines n'ont pas été exemptes de différenciation sociale. Les intérêts et les préoccupations des femmes les plus démunies n'ont pas été prises en compte.

Enfin, les projets basés sur le lien entre les femmes et l'environnement, promus par la démarche WED (« Women, Environment and Development ») ont occulté les questions concernant la propriété et le pouvoir. Les programmes ont donné aux femmes la responsabilité de «sauver l'environnement» sans se demander si elles avaient réellement les ressources et la capacité de le faire (Leach, 2007).

Néanmoins les évolutions sont réelles. D'après les enquêtes réalisées, c'est d'abord le gain de liberté individuelle obtenu grâce aux activités d'agroécologie qui est mis en avant. Le premier impact est financier. Les femmes peuvent compter sur des revenus personnels. Dans les communautés quilombolas, toutes les femmes ont déclaré assez fièrement pouvoir décider de façon complètement autonome la destination des revenus provenant de cette activité « *mon travail, mon argent* ».

Un autre point important de la situation des femmes est la violence domestique, souvent liés à l'alcoolisme. Les enquêtes ne permettent pas d'établir des corrélations entre violences et le niveau de scolarisation, l'âge, l'occupation etc. Cependant faire partie de réseaux agroécologiques permet aux femmes d'avoir accès à des formes de protection, de partage et de conscientisation collective. Mais en cas d'augmentation de violence domestique, qui peut d'ailleurs être due à la participation aux activités des associations (réunions, formations, etc.), le manque de mesures spécifiques et réelles d'accompagnement et de soutien aux femmes battues est patent. Cela est vrai pour le mouvement et les services de l'Etat. Les femmes restent généralement délaissées.

5.8 Discussion et recommandations

L'agroécologie développée dans le municipe de Santa Luzia a une connotation fortement féminine. Tout d'abord, l'agroécologie est ici une agroécologie d'extractivisme, où les femmes occupent un rôle historiquement déterminant. Dans les activités plus agricoles, le rôle des hommes est plus affirmé. En ce sens, l'agroécologie traduit encore des vieilles divisions du travail qui se sont modifiées ces dernières années.

Le renforcement des compétences, axe privilégié du mouvement et des réseaux agroécologiques a favorisé la prise de conscience des femmes, leur autonomie financière, leur accès au marché, leur prise de responsabilité dans les instances de gestion et, en conséquence, un

pouvoir de décision renforcé dans les activités agricoles. Ces progrès restent néanmoins limités. La domination, à la fois sur l'agriculture familiale, dans son ensemble, et sur les femmes, en particulier, ne peut s'estomper que dans le temps long.

Comment renforcer ces évolutions positives ? Faut-il prioritairement consolider les pratiques égalitaires existantes dans les activités extractivistes en les étendant aux autres activités ? Ou faut-il engager une réflexion globale pour modifier les pratiques de gestion agricoles des hommes ? Il serait alors nécessaire d'insérer l'égalité de genre et la valorisation du travail des femmes comme critères de certification et donc de qualification de produits/processus/organisations agroécologiques. C'est le mot d'ordre que revendique la totalité des militantes brésiliennes « *Pas d'agroécologie sans féminisme* » (Prevost, et al. *ibid.*). Ces critères viendraient s'ajouter à ceux techniques de non utilisation de pesticides. Cela implique aussi des conditions égales de salaires et de droits entre hommes et femmes, une participation réelle des femmes au sein des institutions d'intermédiations agricoles (coopératives de commercialisation, services de divulgation etc.) et une lutte contre toutes les formes de violence contre les femmes.

Une autre action pourrait être de favoriser l'implication active des hommes au sein des mouvements et des groupements des femmes et développer autant que possible des activités mixtes, tout en fournissant des services d'assistance spécifique pour les femmes (comme par exemple des services de garderie pour les enfants pendant les moments de formation collective etc.).

L'analyse de l'impact des expériences agroécologiques en termes d'égalité de genre, soulève un certain nombre de constatations :

- L'insuffisante « quantification » de la présence des femmes en agroécologie, en particulier dans les statistiques officielles, où le manque de données désagrégées par sexe traduit le manque de valorisation et reconnaissance du rôle des femmes dans l'agroécologie.

- Dans cette perspective, il est nécessaire de proposer et d'aboutir à des outils de suivi-évaluation et d'accompagnement autour du genre et agroécologie, outils qui puissent aussi favoriser et accompagner l'institutionnalisation de l'agroécologie.

- La richesse amenée par les perceptions et perspectives des acteurs locaux. Elle doit être prise en considération dans le processus d'élaboration à la fois des politiques et des outils de suivi-évaluation.

Dans cette perspective, la proposition d'un cadre d'analyse de genre - y compris des indicateurs - à appliquer spécifiquement aux expériences agro écologiques serait à développer dans les prochaines étapes de la recherche. Un tel cadre pourrait s'inspirer des travaux très intéressants menés en Equateur (De Marco Larrauri et al., 2016).

Un autre chantier est celui de la pérennité et de la continuité des actions. Cela pose la question de la transmission des savoirs et des connaissances vers les jeunes mais aussi des jeunes élèves vers les adultes et leurs familles/communautés d'origine. Cette interaction entre les différentes classes d'âge est porteuse de reconnaissance des genres et d'une meilleure «égalité entre femmes et hommes mais aussi entre adultes et jeunes ». Elle est aussi porteuse d'améliorations des pratiques au niveau environnemental. Le vrai défi est donc de donner plus de voix et de poids aux jeunes et aux femmes, en tant que porteurs de changement en agissant comme pont entre tradition et innovations durables.

Cette question pose en filigrane la question des politiques publiques et de leurs orientations. Après 20 ans d'ouverture et de modernisation de la société, les évolutions récentes au Brésil semblent aller vers une remise en cause de l'agroécologie, du développement durable et de la place de la femme. Tous les interlocuteurs évoquent la remise en cause du processus de réformes, notamment celles liées aux questions sociales et environnementales.

BIBLIOGRAPHIE

- Altieri M A. 2002. Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agriculture, ecosystems & environment* 93(1): 1-24. DOI: [https://doi.org/10.1016/S0167-8809\(02\)00085-3](https://doi.org/10.1016/S0167-8809(02)00085-3)
- Amekawa Y. 2010. Rethinking sustainable agriculture in Thailand: A governance perspective. *Journal of Sustainable Agriculture* 34(4): 389-416. DOI: <https://doi.org/10.1080/10440041003680254>
- Boserup E, Kanji N. 2007. Woman's role in economic development. Earthscan, 270 p.
- Cornwall A. 2016. Women's Empowerment: What Works? *Journal of International Development* 28(3): 342-359. DOI: 10.1002/jid.3210
- Butto A, Dantas I. 2011. *Autonomia e cidadaniapolíticas de organização produtiva para as mulheres no meio rural* (No. IICA). Ministério do Desenvolvimento Agrário (Brasil) IICA, Brasília, DF (Brasil).
- De Marco Larrauri O, Pérez Neira D, Soler Montiel M. 2016. Indicators for the Analysis of Peasant Women's Equity and Empowerment Situations in a Sustainability Framework: A Case Study of Cacao Production in Ecuador. *Sustainability* 8(12): 12-31. DOI: 10.3390/su8121231
- FAPESPA – Fundação Amazônia de Amparo a Estudos e Pesquisas 2016. Estatística municipal. Santa Luzia do Pará, Bélem.
- Food and Agricultural Organisation - FAO. 2013. No Brasil, 13% dos agricultores são mulheres. Notícias FAO. [2017/10/18]. <http://www.fao.org/americas/noticias/ver/es/c/230178/>
- FAO. 2011. The State of Food and Agriculture: Women in Agriculture. Closing the gender gap for development. Rome, Italy.
- Ferro S. 2014. Estudio comparativo regional de asistencia técnica y extensión rural con perspectiva de género. Programa Regional de

Género de la Reunión Especializada de la Agricultura Familiar del Mercosur (REAF). [2017/09/23].

<https://dspace.unila.edu.br/xmlui/bitstream/handle/123456789/1742/FERRO%20Asistencia%20Tecnica%20y%20Extensi%C3%B2n%20Rural%20oestudio%20comparativo%20regional.pdf?sequence=1>

Leach M. 2007. Earth Mother Myths and Other Ecofeminist Fables: How a Strategic Notion Rose and Fell, *Development and Change* 38(1): 67–85. DOI: 10.1111/j.1467-7660.2007.00403.x

Lima M M T, de Jesus V B. 2017. Questões sobre gênero e tecnologia na construção da agroecologia. *Scientiae Studia* 15(1): 73-96. DOI: <http://dx.doi.org/10.11606/51678-31662017000100005>

Meinzen-Dick R, Kovarik C, Quisumbing A R. 2014. Gender and sustainability. *Annual Review of Environment and Resources* 39(1): 29. DOI: <https://doi.org/10.1146/annurev-environ-101813-013240>

Milgroom J. 2015. Women forging change with agroecology, *Farming Matters* 31(4), Ileia eds., Wageningen, Netherlands.

Nobre M. 2005. Quand la libération des femmes rencontre la libération des semences. *Mouvements* (4): 70-75. DOI: 10.3917/mouv.041.0070

Prévost H, Esmeraldo G G S L, Guetat-Bernard H. 2014. Il n'y aura pas d'agroécologie sans féminisme: l'expérience brésilienne. *Pour* 2 (222): 275-284. DOI: 10.3917/pour.222.0275

Quisumbing A R, Pandolfelli L. 2010. Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. *World Development* 38(4): 581-592. DOI: <https://doi.org/10.1016/j.worlddev.2009.10.006>

Rieu A, Dahache, S. 2008. S'installer comme agricultrice: sur la socialisation et la formation sexuée en agriculture. *Revue d'études en agriculture et environnement* 88(3): 71-94.

Rosset PM, Machin Sosa B, Roque Jaime A M, Ávila Lozano D R. 2011. The Campesino-to-Campesino agroecology movement of ANAP in Cuba: social process methodology in the construction of sustainable

peasant agriculture and food sovereignty. *The Journal of peasant studies* 38(1): 161-191. DOI: <https://doi.org/10.1080/03066150.2010.538584>

Sachs C. 1996. Gendered fields: rural women, agriculture, and environment. Westview Press, Inc, 205p.

Siliprandi E. 2015. Mulheres e agroecologia: transformando o campo, as florestas e as pessoas. Editora UFRJ, 356p.

Shiva V. 1997. Reduccionismo y regeneración: crisis en la ciencia. In Mies M, Shiva V, ed, *Ecofeminismo. Teoría, crítica e perspectivas*. Barcelona (España): Icaria, Antrazyt, pp.61.

Tonneau J P, Teixeira O A. 2002. Políticas Públicas e Apoio Institucional à Agricultura Familiar no Brasil: agroecologia e estratégias de desenvolvimento rural. *Raizes* 21(2): 295–303

6. CONCLUSIONS

The general goal of the thesis was to investigate, assess, and contribute to evaluate the role of women in family farming agriculture and in sustainable development, with a specific focus on two southern countries areas: some central regions of Senegal and an Amazonian state of Brazil.

6.1 Main achievements around gender indicators after their application in the case studies

The analysis and application of different gender indicators to the sample contexts produced several key points, theoretical and methodological inspirations, and possible future developments of the Ph.D research.

Studying the ways and the implications due to the implementation of gender indicators in the framework of different rural development project contexts led to the following considerations.

The difficulty to switch from the official discourse to the field. A huge gap exists between advocating for the need to gather gender-disaggregated data and indicators and the concrete process to effectively achieve them. This gap is caused among others by: the frequent lack of data in agriculture and at local level, the failures of awareness and acknowledgment around the role of women in the productive process, the limited offer of technical trainings and assistance more gender-oriented, and the scarce political support.

Which empowerment? By/for whom? Studying gender issues in different contexts allowed to clearly understand that does not exist a unique universal definition of empowerment. People can more or less agree about some main general values behind, but at the same time we have seen how it is difficult even to identify a core of common criteria -and thus the relating suitable indicators - to measure and assess such whole concepts.

The context matters, but even the scale of analysis, the typology of actors, and the institutional environment. The differences on gender issues are visible even between regions, organizations (as FOs), households, and individuals.

Indicators alone do not work, because they are “only” numbers and they can be used to show only a limited part of the world. For such reasons they should be framed in a more large gender analysis, including qualitative and participatory methods and in coordination with the policy making process.

The whole process counts. In order to effectively operationalize gender mainstreaming in the field we should realize in depth gender analyses all along the process, collect, use and give back data through a gender lens. Too often this cycle does not result in a real use of data to influence the decision making and the correct implementation of development programmes. Too often data remain in the hands of researchers and are not bring back to the interviewees because of lack of time, resources, and suitable methods.

Not only gender experts. The study of gender issues through the use of gender indicators was realized within programmes not directly directed to gender empowerment promotion (even if women were more or less the main beneficiaries) and the research was carried out with the help of different key informants and researchers, very rarely with a gender expertise. Nonetheless, these uncommon aspects represented a richness of the research, because they allow to understand better the internal difficulties to work on gender issues and to effectively communicate and share about this topic even among the same practitioners.

With regards to the aim to study the connection between gender equality, sustainability, and agroecology, we can see that:

a) generally a greater gender equality in the joint management of natural and agricultural resources allowed a more sustainable use and

management of them (as largely stressed by Agarwal, 2010). Nonetheless a strong shortcoming is related to the scarce gender equality within the organizations in charge of the management and decision tasks (as management committees, farmer organisations, water user associations, cooperatives, etc.);

b) gender equality may positively affect the sustainability of development programmes and policies. Nonetheless it is not always true the opposite, first because the same concept of sustainability can differ from each actor (e.g. for an agribusiness entrepreneur it could mean economic sustainability and increased profits), second because excessively emphasizing the link between women and environment can create negative unplanned effects in terms of women empowerment (UN WOMEN, 2014).

6.2 Agroecology, gender equality and sustainability

The last part of the research, expressively designed around the analysis of the link between agroecology, gender equality, and sustainability, added a further confirmation to such positive effects. Such part of the Ph.D research was driven by the will to operationalize the concepts of sustainability and gender empowerment in the field of rural development experiences. On the basis of the conditions in which generally women are included in the agricultural sector, the initial identified constraints were:

- a) unbalanced gender relations;
- b) different gender functionalities;
- c) different tasks due to the traditional division of agricultural labour.

Following such considerations, the initial research statements were as follows:

- a) women are marginalized actors in agriculture;
- b) it is necessary to find other alternative ways for them;

c) agroecology can be a suitable solution because of several reasons. First, because it is more accessible to women, second because it is a more open/inclusive model, third since it is more suitable to poor and disadvantaged people (Altieri 2002; Altieri & Toledo, 2011).

During the field work carried out in Brazil, three main features regarding the local agroecology context and definitions appeared:

1. the importance of the whole core of values behind;
2. the most performance aspects, as the organic labels;
3. the link with the disadvantaged people.

Such features more or less directly corresponded to some specific local actors as follows:

1. the institutional actors (as researchers, activists, farmer organizations leaders);
2. the main “market-oriented” producers (as the farmers selling in the organic market of Belém);
3. the actors generally excluded by the big agribusiness models.

Local women were present in each category of actors and we did not record any differences between women and men in the definitions of agroecology provided. What changed was the different attitude and knowledge towards the local natural and agricultural resources and the agricultural specialisation.

On the basis of the results came from this field survey, we can say that the agroecological practices generally contributed to better living conditions and thus empowerment for the local women farmers. This was visible in terms of greater financial autonomy and thus better self-confidence and decision power within the household and the community. Looking at the initial mentioned theoretical “division” between the WED and the GED approaches, we can state that in the sample women are more involved in the most ecological and less economically valuable practices both because of an “informal” labour division and exclusion by the most mechanical and technological agricultural activities, both

because the knowledge and the transmission of such knowledge passed only between mother and daughter or grandmother and granddaughter. In this sense we can affirm that there is not a unique interpretation and dynamic explaining the connection between women, agroecology, and sustainability but rather a combination of practical and cultural reasons, and shortcomings. If on one hand, the influence of more sustainable practices towards greater women empowerment has been partially proved, we cannot surely confirm that provided that women have equal access to resources as men, women would choose again the most ecological but less profitable agricultural practices. At the same time, the diffused greater awareness and activism of the local women towards the importance of the environment protection, and the link with improved nutrition levels clearly emerged during the survey.

6.3 A gender sustainable framework for agroecology?

Mainstreaming gender in research and development is becoming an imperative for the international agenda. Even social and natural sciences are dealing with the challenge to incorporate such dimensions and to find the suitable ways and means to measure and assess gender issues. Actually, literature produced a quite large number of sustainable assessment frameworks (Lopez et al., 2002; Gómez-Limón & Sanchez-Fernandez, 2010), sustainable livelihoods and gender frameworks (Addinsall et al., 2015; Moser, 1995; 2003 Kabeer 1996) even applied to agricultural contexts (Meinzen-Dick et al. 2011). However, what is quite lacking is the proposal of a joint gender sustainable framework, including a set of indicators, specifically designed also to agroecology.

The main remarkable attempt is represented by a research recently carried out in Ecuador (De Marco Larrauri, et al. 2016) which proposed and started to apply a set of gender indicators to agroecology experiences. The authors identified 34 empowerment indicators organized into six basic theoretical dimensions: access to resources,

education and social participation; economic-personal autonomy and self-esteem; gender gaps (labour rights, health, work and physical violence); techno-productive decision-making and remunerated work; land ownership and mobility; diversification of responsibilities and social awareness.

Our proposal of gender framework and relative indicators takes inspiration from the previous studies which were generally strongly economics or natural sciences oriented. The original feature of the proposed framework is related to the will to more largely stress and enhance the social sciences components of the previous models. Such considerations originates both from the previous background of the Ph.D candidate and both for the necessity to expand the traditional core of the previous gender sustainability frameworks. During the research, we then tried to keep the multiple dimensions behind the concepts of sustainability and gender equality and to make the comprehension and the application of such framework more friendly and appropriated by both local stakeholders and minor development practitioners.

The proposed gender sustainable framework should be seen as an analytical structure to favourite a broader and systematic understanding of the various elements influencing the link between agroecology and gender equality and to show how they relate to each other. A possible way to achieve these goals could be the extrapolation framework, often used by natural scientist but readapted to the necessity of the social and gender research (as done for the agro forestry sector by Catacutan, et al. in 2014). The extrapolation framework combines biophysical, gender disaggregated socioeconomic and anthropological parameters for determining the pre-conditions for the adoption of a preferred technology. Despite the undeniable potentially and completeness of this framework, conversely this model appears too much complex to be implemented in the field and maybe even own and mastered by a huge core of users, except the more skilled.

The next step of this Ph.D research foresees the finalization and the test of a drafted gender framework in the field (both in Brazil and in Senegal within old and new agroecological experiences), the progressive adaptation of such framework on the basis of the previous testing phase, and a continuous process of discussion and validation of such tool by a core of selected local stakeholders and international experts.

6.4 Conclusive remarks

The importance of gender equality and women's empowerment in achieving sustainable development has been increasingly recognized since decades. However, if gender equality can have positive impacts in terms of socio-economic and environmental sustainability, the opposite relation does not always works. Considering women as "sustainability saviours" may reinforce traditional stereotypes on "traditional" women's roles (UN WOMEN, 2014). For such raisons the study of the connections between gender equality and sustainable development must be carefully carried out with a specific attention to the local context of analysis and to the whole variables behind such connections. Simultaneously, the joint achievement of sustainability and gender equality may generate some trade off or overlapping between their different goals. At the same time, the different dimensions of sustainability may include diverse and controversial effects in terms of gender equality (e.g. increased workload for the women in charge of environmental protections duties etc.) (UNDP, 2011).

This three-years research allowed to understand the many complexities behind both the relations between women empowerment and sustainability in agriculture and the ways to measure and assess such relations. We can identify both theoretical problems (as achieving shared definitions of such concepts, the debate between the importance of the local context, and the proposal of universal tools), methodological difficulties (lack of gender disaggregated data, conspicuous human and

financial resources for gather data, logistic difficulties) and policies constrains (limited national support and awareness about the importance and the effective implementation of these topics in the field). Gender indicators may be a suitable tool to decompose, contextualize and show the several components influencing the differences conditions of women and men active in agriculture. However, at the same time gender indicators risk to complicate the studied phenomena. Some ways to deal with such shortcomings are to join the use of gender indicators with other types of methods, more qualitative and participatory oriented, also including analytical framework and tools less elaborated and more closed to the target population. Proposing gender indicators applied to a specific field as agroecology may be a successful attempt because of the several positive aspects already mentioned. However, this process should be carefully implemented, taking into account the risk to excessively frame and institutionalize a discipline as agroecology, whose constituent strength is often the informality.

7. REFERENCES

- Addinsall, C., Glencross, K., Scherrer, P., Weiler, B., & Nichols, D. (2015). Agroecology and sustainable rural livelihoods: a conceptual framework to guide development projects in the Pacific Islands. *Agroecology and Sustainable Food Systems*, 39(6), 691-723.
- Agarwal, B. (2010). Does women's proportional strength affect their participation? Governing local forests in South Asia. *World development*, 38(1), 98-112.
- Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., & Vaz, A. (2013). The women's empowerment in agriculture index. *World Development*, 52, 71-91.
- Altieri, M. A. (2002). Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agriculture, ecosystems & environment*, 93(1), 1-24.
- Altieri, M. A. (2009). Agroecology, small farms, and food sovereignty. *Monthly review*, 61(3), 102.
- Altieri, M. A., & Toledo, V. M. (2011). The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants. *Journal of Peasant Studies*, 38(3), 587-612.
- Agence Nationale de la Statistique et de la Démographie du Sénégal, Senegalese National Statistic Agency, ANSD (2018). Le Sénégal en bref, available at <http://www.ansd.sn/> (accessed on 4 January 2018)
- Bamberger, M., Rao, V., & Woolcock, M. (2010). Using mixed methods in monitoring and evaluation: experiences from international development. *Policy Research Working Paper 5245*, The World Bank, Washington DC, USA.
- Barrow, C. J. (1999). *Environmental management: principles and practice*. Routledge, London, UK.

- Beneria, L., & Permanyer, I. (2010). The measurement of socio-economic gender inequality revisited. *Development and Change*, 41(3), 375-399.
- Bergold, J., & Thomas, S. (2012). Participatory research methods: A methodological approach in motion. *Historical Social Research/Historische Sozialforschung*, 191-222.
- Bradbury-Huang, H. (2010). What is good action research? Why the resurgent interest?. *Action Research*, 8(1), 93-109.
- Brown, A. M. (2007). WID and GAD in Dar es Salaam, Tanzania: Reappraising gender planning approaches in theory and practice. *Journal of Women, Politics & Policy*, 28(2), 57-83.
- Catacutan D., McGaw E., Llanza M. A. (2014). *In Equal Measure: A User Guide to Gender Analysis in Agroforestry*. World Agroforestry Centre (ICRAF) Southeast Asia Regional Program, Los Baños, Philippines.
- Chambers, R. (1992). Rural appraisal: rapid, relaxed and participatory, *IDS Discussion Paper 311*, Institute of Development Studies, Brighton UK.
- Chambers, R. (1994). Participatory rural appraisal (PRA): Analysis of experience. *World development*, 22(9), 1253-1268.
- Chianca, T. (2008). The OECD/DAC criteria for international development evaluations: An assessment and ideas for improvement. *Journal of Multidisciplinary Evaluation*, 5(9), 41-51.
- Connell, J. P., & Kubisch, A. C. (1998). Applying a theory of change approach to the evaluation of comprehensive community initiatives: progress, prospects, and problems. *New approaches to evaluating community initiatives*, 2(15-44), 1-16.
- Cornwall, A. (2003). Whose voices? Whose choices? Reflections on gender and participatory development. *World development*, 31(8), 1325-1342.

- Cornwall, A., & Anyidoho, N. A. (2010). Introduction: Women's empowerment: Contentions and contestations. *Development*, 53(2), 144-149.
- Cornwall, A., & Rivas, A. M. (2015). From 'gender equality and 'women's empowerment' to global justice: reclaiming a transformative agenda for gender and development. *Third World Quarterly*, 36(2), 396-415.
- Dalle, S. P., & Walsh, S. (2015). USC Canada's experience in supporting community seed banks in Africa, Asia and the Americas. In Vernooy R., Shrestha P., Sthapit B. (2015) *Community Seed Banks. Origins, Evolution and Prospects*, Routledge, New York, USA.
- Davis, K. (2012). *Governance by indicators: global power through classification and rankings*. Oxford University Press, Oxford, UK.
- De Marco Larrauri, O., Pérez Neira, D., & Soler Montiel, M. (2016). Indicators for the analysis of peasant women's equity and empowerment situations in a sustainability framework: A case study of cacao production in Ecuador. *Sustainability*, 8(12), 1231.
- Department for International Development, DFID (2014). Agriculture and women. Agriculture and growth evidence paper series, UK AID, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/318355/Ag_and_women__final_.pdf (accessed on 11 November 2017).
- De Sardan, J. P. (1995). La politique du terrain. Sur la production des données en anthropologie. *Enquête. Archives de la revue Enquête*, (1), 71-109.
- De Schutter, O. (2011). Agroecology: A path to realizing the right to food. *Food First Backgrounder*, 17(2), 1-5.
- Doss, C. (2014). Data needs for gender analysis in agriculture. In Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A., & Peterman, A. (2014). *Gender in agriculture: closing the knowledge gap*. Springer.

Dijkstra, A.G. (2006). Towards a fresh start in measuring gender equality: A contribution to the debate. *Journal of Human Development*, 7(2), 275-283.

Food and Agriculture Organisation, FAO (2001). Field level handbook. Socio-economic and Gender Analysis Programme (SEAGA), Rome.

Food and Agricultural Organisation, FAO (2011). The State of Food and Agriculture: Women in Agriculture. Closing the gender gap for development. Rome, Italy.

Food and Agriculture Organisation, FAO (2013). The Gender and Equity Implications of Land-Related Investments on Land Access, Labour and Income-Generating Opportunities: A Case Study of Selected Agricultural Investments in Zambia, Rome, Italy. Available at <http://www.fao.org/docrep/018/aq536e/aq536e.pdf> (accessed on 12 January 2018).

FAOSTAT (2018a). FAO statistical yearbook. Senegal. Available at <http://www.fao.org/faostat/en/#country/195> (accessed on 24 January 2018).

FAOSTAT (2018b). FAO statistical yearbook. Brazil. Available at <http://www.fao.org/faostat/en/#country/21> (accessed on 24 January 2018).

Fitzpatrick I. (2015). From the roots up. How agroecology can feed Africa, Global Justice Now. Available at <https://www.globaljustice.org.uk/sites/default/files/files/resources/agroecology-report-from-the-roots-up-web-version.pdf> (accessed on 8 January 2018).

Gianotten, V., Groverman, V., Walsum, E. V., & Zuidberg, L. (1994). Assessing the gender impact of development projects: case studies from Bolivia, Burkina Faso and India, Royal Tropical Institute, Amsterdam, the Netherlands.

Gómez-Limón, J. A., & Sanchez-Fernandez, G. (2010). Empirical evaluation of agricultural sustainability using composite indicators. *Ecological economics*, 69(5), 1062-1075.

Governo do Estado do Pará (2018). Apresentação geral do Estado, available at http://www.pa.gov.br/O_Para/ (accessed on 3 January 2018)

Hay, K. (2012). Theory of Change: An Introduction for the Engendering Policy through Evaluation Project', ISST Workshop, 20-22 September 2012, Hyderabad, India. Available at http://feministevaluation.org/memberlogin/images/stories/Katherine_Hay_Theory_of_change1.pdf (accessed on 17 August 2017).

Instituto Brasileiro de Geografia e Estatística, IBGE (2009). Agricultural Census 2006. Available at https://biblioteca.ibge.gov.br/visualizacao/periodicos/51/agro_2006.pdf (accessed on 03 January 2018).

International Labour Organization, ILO (1998). On Line Gender Learning & Information Module, available at <http://www.ilo.org/public/english/region/asro/mdtmanila/training/unit1/harvrdfw.htm> (accessed on 18 august 2017).

Kabeer, N. (1994). *Reversed realities: Gender hierarchies in development thought*. Verso, London, UK.

Kabeer N. (1995). Targeting women or transforming institutions? Policy lessons from NGOs' anti-poverty efforts, *Development in Practice*, 5(2), 108-116.

Kabeer, N., & Subrahmanian, R. (1996). Institutions, relations and outcomes: framework and tools for gender-aware planning. Institute of Development Studies, IDS, Brighton, UK.

Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment. *Development and change*, 30(3), 435-464.

Kabeer, N. (2001). Resources, agency, achievements. *Discussing Women's Empowerment*, 3, 10-17.

- Kabeer, N. (2005). Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1. *Gender & Development*, 13(1), 13-24.
- Kachika T. (2011). Land Grabbing in Africa: A Review of the Impacts and Possible Policy Responses, Oxfam. Available at <http://tinyurl.com/p8qeaqp>(accessed 9 December 2017).
- Karl, M. (1995). *Women and empowerment: Participation and decision making*. Zed Books, London, UK.
- Kates, R.W., Parris, T.M., Leiserowitz, A.A (2005). What is sustainable development? Goals, indicators, values, and practice. *Environment: Science and Policy for Sustainable Development*, 47 (3), 8-21.
- Kerr, R. B. (2008). Gender and agrarian inequality at the local scale. In S. Snapp, & B. Pound (1st. Eds.) (2008), *Agricultural systems: Agroecology and rural innovation for development*. Elsevier, Burlington, USA.
- Klasen, S., & Schüler, D. (2011). Reforming the gender-related development index and the gender empowerment measure: Implementing some specific proposals. *Feminist Economics*, 17(1), 1-30.
- Krishnan A. (2017). Theory of Change, The Abdul Latif Jameel Poverty Action Lab, South Asia available at <https://www.povertyactionlab.org/sites/default/files/event/Lecture%20-THEORY%20OF%20CHANGE.pdf> (accessed on 16 September 2017).
- Kuhlman, T., & Farrington, J. (2010). What is sustainability? *Sustainability*, 2(11), 3436-3448.
- Kumar, A. (2016). Complementing Gender Analysis Methods. *Journal of evidence-informed social work*, 13(1), 99-110.
- Lappé, F. M. (2016). Farming for a small planet: Agroecology now. *Great Transition Initiative*, 1-14.
- Leach, M. (2007). Earth Mother Myths and Other Ecofeminist Fables: How a Strategic Notion Rose and Fell, *Development and Change*, 38(1): 67–85.

- Longwe, S. H. (1995). The evaporation of policies for women's advancement. In Heyzer N., Kapoor S., Sandler J., eds. (1995) *Commitment to the world's women: perspectives on development for Beijing and beyond*, United Nations Development Fund for Women, UNIFEM, New York, USA.
- Longwe, S. H. (2002). Addressing rural gender issues: a framework for leadership and mobilisation. Paper presented at the *III World Congress for Rural Women*, 2-4 October 2002, Madrid, Spain.
- López-Ridauro, S., Masera, O., & Astier, M. (2002). Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecological indicators*, 2(1), 135-148.
- Malhotra, A., & Schuler, S. R. (2005). Women's empowerment as a variable in international development. *Measuring empowerment: Cross-disciplinary perspectives*, 71-88.
- March, C., Smyth, I. A., & Mukhopadhyay, M. (1999). *A guide to gender-analysis frameworks*. Oxfam GB, London, UK.
- Meinzen-Dick, R., N. Johnson, A. Quisumbing, J. Njuki, J. Behrman, D. Rubin, A. Peterman, and E. Waitanji (2011). Gender, Assets, and Agricultural Development Programs: A Conceptual Framework. *CAPRI Working Paper No. 99*. International Food Policy Research Institute, Washington DC, USA.
- Meinzen-Dick, R., Kovarik, C., & Quisumbing, A. R. (2014). Gender and sustainability. *Annual Review of Environment and Resources*, 39(1), 29.
- Mela A., (2017) Ph.D class on social research methodology, May 2017, Ph.D on Urban and Regional Development, Turin, Italy.
- Mies, M., & Shiva, V. (1993). *Ecofeminism*. Zed Books, London, UK.
- Mikkelsen, C. (2005). Indigenous peoples, gender, and natural resource management, *DIIS working paper 5*, Danish Institute for International Studies, Copenhagen, Denmark.
- Molle, F., & Mollinga, P. (2003). Water poverty indicators: conceptual problems and policy issues. *Water policy*, 5(5-6), 529-544.

- Moser, C.O.N. (1995). Evaluating gender impacts. *New Directions for Evaluation*, 1995(67), 105-117.
- Moser, C.O.N. (2003). *Gender planning and development: Theory, practice and training*. Routledge, New York, USA.
- Moser, C.O.N. (2005a). An introduction to gender audit methodology: Its design and implementation in DFID Malawi, Overseas Development Institute, London, UK.
- Moser, C.O.N. (2005b). Has gender mainstreaming failed? A comment on international development agency experiences in the South. *International Feminist Journal of Politics*, 7(4), 576-590.
- Moser, C.O.N., & Moser, A. (2005). Gender mainstreaming since Beijing: a review of success and limitations in international institutions. *Gender & Development*, 13(2), 11-22.
- Moser, A. (2007). *Gender and indicators: overview report*. Bridge, Institute of Development Studies, Brighton, UK.
- Ndiaye, A. (2013). *L'agriculture sénégalaise de 1958 à 2012: analyse systémique et prospective*. Editions L'Harmattan, Paris, France.
- Nobre, M. (2005). Quand la libération des femmes rencontre la libération des semences. *Mouvements*, (4), 70-75.
- Oakley, A. (1972). *Sex, Gender and Society*, Ashgate, Farnham, UK.
- Organisation for Economic Co-operation and Development, OECD (1991). DAC Criteria for Evaluating Development Assistance, Paris, France. Available at <http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm>. (accessed on 25 August 2017)
- Parker, A. R. (1993). *Another point of view: a manual on gender analysis training for grassroots workers*, United Nations Development Fund for Women, New York, USA.
- Parpart, J. L., Connelly, P., & Barriteau, E. (2000). *Theoretical perspectives on gender and development*. International Development Research Centre, IDRC, Ottawa, Canada.

- Pélissier, P. (1966) *Les paysans du Sénégal. Les civilisations agraires du Cayor à la Casamance*, Fabrègue, Saint-Yrieix, France.
- Permanyer, I. (2010). The measurement of multidimensional gender inequality: Continuing the debate. *Social Indicators Research*, 95(2), 181-198.
- Peterman, A., Behrman, J. A., & Quisumbing, A. R. (2014). A review of empirical evidence on gender differences in nonland agricultural inputs, technology, and services in developing countries. In Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A., & Peterman, A. (2014). *Gender in agriculture: closing the knowledge gap*. Springer, Dordrecht, the Netherlands.
- Prévost, H., Esmeraldo, G. G. S. L., & Guetat-Bernard, H. (2014). Il n'y aura pas d'agroécologie sans féminisme: l'expérience brésilienne. *Pour*, (2), 275-284.
- Quisumbing, M. A. R., & McClafferty, B. F. (2006). *Food security in practice: Using gender research in development*. International Food Policy Research Institute, Washington DC, USA.
- Quisumbing, A. R., & Pandolfelli, L. (2010). Promising approaches to address the needs of poor female farmers: Resources, constraints, and interventions. *World Development*, 38(4), 581-592.
- Rao A., Anderson M.B. & Overholt C.A. (1991). *Gender analysis in development planning: a case book*, Kumarian Press, West Hartford, Connecticut, USA.
- Reij C., Tappan G. & Smale M. (2009). Agroenvironmental Transformation in the Sahel: Another Kind of 'Green Revolution', *IFPRI discussion paper 914*. Available at <http://cdm15738.contentdm.oclc.org/utis/getfile/collection/p15738coll2/id/15847/filename/15848.pdf> , accessed 13 December, 2017.
- Rubin, G. (1975). The Traffic in Women. Notes on the 'Political Economy of Sex'. In Reiter R. R. (1975) *Toward an Anthropology of Women*. Monthly Review Press, New York, USA.

- Sall, M. (2015). *Les exploitations agricoles familiales face aux risques agricoles et climatiques: stratégies développées et assurances agricoles* (Doctoral dissertation, Université Toulouse le Mirail-Toulouse II).
- Shiva, V. (2016). *The violence of the green revolution: Third world agriculture, ecology, and politics*. University Press of Kentucky, Lexington, Kentucky, USA.
- Small, M. L. (2011). How to conduct a mixed methods study: Recent trends in a rapidly growing literature. *Annual review of sociology*, 37.
- Tonneau, J. P., & Teixeira, O. A. (2002). Políticas públicas e apoio institucional à agricultura familiar no Brasil: agroecologia e estratégias de desenvolvimento rural. *Raízes-Revista de Ciências Sociais e Econômicas*, 21(02), 295-303.
- Tonneau, J. P. (1994). Thèse de Doctorat. Modernisation des espaces ruraux et paysannerie: le cas du Nordeste du Brésil, Paris 10 (Doctoral dissertation, Paris 10), France.
- United Nations, UN (2018). The Sustainable Development Agenda. Available at <http://www.un.org/sustainabledevelopment/development-agenda/> (accessed on 20 January 2018).
- United Nations Development Programme, UNDP (2011). Human Development Report 2011: Sustainability and Equity. A Better Future for All. Basingstoke, Palgrave Macmillan, UK.
- United Nations Educational, Scientific and Cultural Organisation, UNESCO (2015). A Guide for Gender Equality in Teacher Education Policy and Practices, Paris, France. Available at <http://unesdoc.unesco.org/images/0023/002316/231646e.pdf> (accessed on 24 June 2017).
- United Nations Evaluation Group, UNEG (2011). Integrating Human Rights and Gender Equality in Evaluation. Towards UNEG Guidance. Available at:

<http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/IOS/temp/HRGE%20Handbook.pdf> (accessed on 20 July 2017).

UN WOMEN (2014). The World Survey on the Role of Women in Development: Gender Equality and Sustainable Development. Available at <http://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2014/world-survey-on-the-role-of-women-in-development-2014-en.pdf?la=en&vs=3045> (accessed on 15 January 2018).

UN WOMEN (2017). World Conferences on Women available at <http://www.unwomen.org/en/how-we-work/intergovernmental-support/world-conferences-on-women> (accessed on 28 January 2018).

Vainio-Mattila, A. (2001). Navigating Gender: A Framework and a Tool Participatory Development. Finland Ministry for Foreign Affairs, Department for International Development Cooperation, Helsinki, Finland. Available at http://www.gdrc.org/gender/framework/gender_01.pdf (accessed on 23 February 2017).

Warren, H. (2007). Using gender-analysis frameworks: theoretical and practical reflections. *Gender & Development*, 15(2), 187-198.

Wezel, A., & Jauneau, J. C. (2011). Agroecology—interpretations, approaches and their links to nature conservation, rural development and ecotourism. In Campbell, W. B., & Ortíz, S. L. (2011) *Integrating agriculture, conservation and ecotourism: Examples from the field*. Springer, Dordrecht, the Netherlands.

Wezel, A., & Soldat, V. (2009). A quantitative and qualitative historical analysis of the scientific discipline of agroecology. *International Journal of Agricultural Sustainability*, 7(1), 3-18.

World Commission on Environment and Development, WCED (1987). *Our Common Future*, Oxford University Press, New York, USA.