



The role of women in freshwater aquaculture development in Kenya

Fonda Jane Awuor*

Kenya Marine and Fisheries Research Institute, National Aquaculture Research Development and Training Center,
P.O. Box 451 -10230, Sagana, Kenya

*Corresponding author: fondajaneawuor@gmail.com

For many years, aquaculture has been erroneously viewed as a male-dominated sector, offering women inadequate opportunities partly due to the high capital investment requirement and or the technologies linked to the venture. Women work in all areas of the aquaculture value chain but their opportunities have not kept pace with aquaculture growth. Hence, they form a larger component of the poor, limiting their income-generating activities and asset building potential. Gender disaggregated statistics that could track women's engagement in aquaculture activities in Kenya are scanty. Hence, women's presence, influence and interests are invisible. All aquaculture labour practices should embrace the Sustainable Development Goals 5 that focus on gender equality and empowerment of all women and girls. To that end, gender equality must be mainstreamed into aquaculture planning, development, monitoring and evaluation. This will require concerted political efforts by sector leaders, advocates and gender champions, supported by new technical instruments for implementation. The study leverages on incorporating gender lens and making gender visible in every phenomenon, questioning if, how and why processes, opportunities and standards differ systematically for women and men and not solely for women. Finally, it proposes sections where women's engagements can be strengthened to increase the importance of aquaculture production in Kenya.

Keywords: gender-equity, sex-disaggregated, empowerment, sustainable development goals

Introduction

The world has witnessed a steady growth in the aquaculture sector over the years, making it the fastest-growing food production sector that generates significant employment opportunities at various scales (FAO, 2018). Issues of gender in aquaculture have acquired increasing focus but analyses are not evenly distributed globally. Also, funding in gender studies is inadequate. However, such analyses are just commencing though still inadequate (Githukia et al., 2020). Gender in aquaculture research is a prime area due

to its originality and diverse concerns about gender division of labor, the invisible role of women's work in aquaculture, and women's hindrance to factors of production. Research in the agricultural sector has pinpointed the vital role of gender issues like women's inability to access and control productive and personal resources like knowledge, individual income, and skills (Felsing et al., 2000).

KIT et al. (2012) documents three arguments that support the rationale for incorporating gender matters in development. The first argument is on the social justice front that reports that both women and men have an equal mandate to gain

from development. This argument concurs with the Sustainable Development Goal (SDG) 5 that stresses gender equality. The second argument demonstrates the linkages between poverty alleviation and gender equity. Weeratunge et al. (2010) report that nations with reduced gender inequity have achieved higher levels of social well-being and economic growth. The third argument is tied to the business realm, which suggests that inequity leads to inefficient allocation of human resources, resulting in failure to get opportunities for innovations. Schumacher (2014) documents the importance of incorporating a gender perspective in value chain analysis, empowerment, labour division and welfare effects.

In the last decade, Kenya has become one of the fastest aquaculture producers, being the 4th largest aquaculture producer in Africa (FAO, 2017). Despite this, its role in food, income and other values are not equally within reach neither are they spread evenly between women and men of different demographics who rely on aquaculture as a source of livelihood (Ndanga et al., 2013). Women's engagement in aquaculture is hardly counted in fisheries statistics. The database and the theoretical research frameworks are weak, making it hard to know the basics (Farm Africa, 2016). Women work in all sections of the aquaculture value chain, but their opportunities have not kept pace with the sector's rapid growth. Sex-disaggregated statistics that could track women's engagement in aquaculture are scarce; hence women's presence, influence and interests are invisible (Farm Africa, 2016). This has far-fetching implications for enhancing capacity and gender mainstreaming in aquaculture management, development, and of similar significance in ascertaining the protection of women who engage in aquaculture. The development of a robust aquaculture and fisheries sector speaks to a broad set of interrelated goals nationally, regionally, and globally that is (SDG) levels – such as SDG 14 (life under water) that tackles fisheries and aquaculture issues, SDG 5 that focuses on gender equality and empowerment of all women and girls, SDG 8 of inclusive and sustainable economic growth and improved food security and nutrition (SDG 2 and 3), inter alia. This paper elucidates the current knowledge of women engagement in freshwater aquaculture in Kenya by presenting the status of existing evidence

along various fundamental dimensions of gender roles in aquaculture, fish marketing, access and control over assets and resources, technology transfer and the role of education in aquaculture highlighting whenever possible the levels of such engagements. In so doing, this paper identifies critical gaps and pinpoints potential priority areas for future studies and inform policy. Subsequently, opportunities, challenges and possible avenues for transforming aquaculture and giving women equality and empowerment to increase aquaculture production in Kenya are presented.

Methods

This paper is based on an in-depth review and assessment of existing evidence from peer-reviewed journal articles, reports, books and grey literature on the period of 2000 to 2020 using keywords on the theme related to aquaculture development. The study leverages on incorporating gender lens and making gender visible in every phenomenon, questioning if, how and why processes, opportunities and standards differ systematically for women and men and not solely for women (Lwenya et al., 2006). Key thematic areas including activities undertaken in aquaculture by men and women, technology transfer, information and extension and constraints to full participation are tackled. Gaps identified are incorporated and used to refine the recommendations for future research.

Activities undertaken by women in freshwater aquaculture

Pond construction and management

The Kenyan aquaculture sector is dominated by men fish farmers comprising 75% of fish farmers nationwide (Kiumbuku, Mutinda and Bernard 2013; Ole-Moiyoi 2017; Amankwah et al., 2018; Obiero et al., 2019). The low uptake by women, as postulated by Obwanga et al. (2017) is a hindrance to aquaculture's social sustainability. In farm production, women tend to do less physically and technically demanding tasks. Where women are literate and financially capable, they manage farm records. Women's owned aquaculture enterprises are small in scale and turnover and

often combined with other income-generating activities (Kiumbuku, Mutinda, and Bernard, 2013). According to Ndanga et al. (2013), women's roles in aquaculture production are notable but are usually less acknowledged in value chain analyses. Though women contribute, they may not be the final decision-makers regarding production management plans of action or sales. According to Kiumbuku, Mutinda and Bernard (2013), income from the sale of fish during harvest is controlled by men in the men headed households, with women in the female-headed household controlling their incomes. However, some widowed women living with their in-laws reported interference from their in-laws on income sharing. In an empirical study on gender roles and constraints in the aquaculture value chain in Western Kenya, Githukia et al. (2020) found that men made decisions in managing fish farm enterprises and had more control over incomes and profits earned from fish farming than their female counterparts. The ability to have control over income implies having decision making power regarding the expenditures from the income derived, reinvestment in aquaculture or other use. Besides, Githukia et al. (2020) also reported that most of the work women undertake are unpaid and are assumed to be an extension of domestic duties. However, Chete (2019) posits that non-remuneration of women for their productive tasks is discriminatory and hinders productivity. To that end, women's efforts will have to be recognized and rewarded to attain economic growth and food and nutrition security. This will require households, communities and concerted national efforts. The same study also reported that males inherit land compared to females. Old discriminatory traditions in Kenya favor male individuals from inheriting land compared to women, which has persisted over generations.

In Kenya, men engage in pond construction and preparation activities whereas women engage in harvesting, postharvest handling, processing and marketing (Ndanga et al., 2013). In male-headed households, Kiumbuku, Mutinda and Bernard (2013) report that women and children are involved in such duties as fish feeding and application of fertilizers. Compared to Asian countries like Cambodia, ponds in which women do half of the duties linked to aquaculture have higher yields than other ponds. In Bangladesh, when men are

absent, women engage in daily tasks like feeding and fertilization. Due to already heavy domestic workloads, women in southwestern Bangladesh express feeling limited in full participation in the value chain (Shirajee et al., 2010). Indeed, women's engagement in multiple domestic duties consume a significant part of their productive time compared to their male counterparts.

Post-harvest and fish marketing

The aquaculture value chain's post-production nodes are identified as possessing notable gender patterns compared to the production nodes (FAO, 2017). In post-harvest handling along the value chain, Farm Africa (2016) found 71% of women took part in fish processing. Awuor et al. (2019) found estimates of women in the processing nodes as 66%, most of whom were in their active economic years (18-35 years) in Kenya. In Thailand, Goss et al. (2000) document that women in their late teen and early 20s form the bulk of the workforce. Velu et al. (2009) suggest that new product development in aquaculture value chains can offer diverse economic opportunities for women, most of whom have concentrated in the post-harvest segments of the value chain. Dolan (2001) has observed a tendency of benefits allocation in the agri-food chains that are "more profitable." For instance, in fish processing in Kenya, as men join the venture, they seem to displace women (Ndanga et al., 2013; Obiero et al., 2014). This could be explained by Awuor et al. (2019) who reported that inadequate access to credit due to insufficient income sources and the issues of collateral is one of the many challenges that limit fish traders' full participation, the majority of whom are women. Unlike women, men are less constrained to accessing credit facilities since they have assets in the form of factors of production that form collateral, making them highly likely to join and expand their fish trade enterprise and, in the process, displace women.

Aquaculture education

Human capital is key in ascertaining available opportunities to people in society. It is also related to the household's productive capacity and their socio-economic wellbeing. Human capital in a household, occasionally measured

Table 1. Summary of lecturer's information.

	Average age (yrs.)	Male	Female	Function	Full time	Part-time
UOE	Data unavailable					
MSU	51	5	1	Lecturers	1	5
UON	50	9	3	Lecturers	10	2
SEKU	40	5	1	Lecturers	All	None
KARU	54	3	0	Lecturers	All	None

Note

UOE-University of Eldoret

MSU-Maseno University

UON-University of Nairobi

SEKU-South Eastern Kenya University

KARU- Karatina University

as the households' head education level or the average education level of working-age adults, is highly linked to nutritional outcomes, agricultural productivity, and household incomes, all of which impact household socioeconomic well-being at the national level (World Bank, 2007). In a survey to assess aquaculture education programmes in Kenya, Birgen (2019) documented that female students pursuing aquaculture educational programs had a success rate of 75% at the University of Nairobi (UON). At Maseno University (MSU), female students had an equally higher success rate in graduating than their male counterparts. South Eastern Kenya University (SEKU) and Karatina University (KARU) had approximately 99% success rates for both male and female students. The study provides evidence that more women are graduating in aquaculture from higher education institutions in Kenya and gender parity is being achieved in some cases (Birgen, 2019). This could be attributed to the government's efforts on promoting girl child education, empowerment and associated policies. The future female engagement patterns in aquaculture research will be determined by the current student enrollments and graduation levels. This growing trend shows that the gender gap may be narrowing and gender equity improving.

Aquaculture employment

Table 1 summarizes gender segregation amongst aquaculture lecturers in various university in Kenya (Birgen, 2019). The study indicates that women's share in aquaculture's lecturer employment is considerably lower. Therefore,

women are less represented in high-level research, decision-making positions, and management compared to their male counterparts. Table 2 shows data on gender employment in a national research institution (Aquaculture Division) most of whom are male (65.4%). The data shows that while quantitative data on participation is critical, information on participation quality is equally important.

Technology transfer

Aquaculture extension programmes have been inaugurated in Kenya (Ngugi and Manyala, 2009) and access to advisory and support from extension services are prominent leading to more than 30% of fish farmers fully adopting several aquaculture technologies. There has been prosperous attainment of women's inclusion in adopting aquaculture technology in some areas whereby the success is mainly attributed to "judiciously planned interventions with a gendered perspective" (Weeratunge and Jharendu, 2011). Restrictive gender norms in communities should be understood to target the right individuals without bias toward a given cohort. Aquaculture technologies fit for both women's and men's need and preferences and that can lower women's labour and time burdens are essential. There is a positive correlation between the adoption of improved technologies and education (Ngoc et al., 2016) and a positive correlation between the adoption of technologies and improved livelihood outcomes (Obiero et al., 2019). However, the adoption of such technologies relies on the availability of time.

Table 2. Data in Gender employment at KMFRI Aquaculture Division, 2020.

Specialization	Qualification	Male	Female
Fish Nutrition	PhD	1	0
	MSc	2	1
	BSc	1	0
Post-harvest Management and Value Addition	PhD	0	1
	MSc	0	0
	BSc	0	0
Fish Health Management and Nutrition	PhD	0	1
	MSc	0	0
	BSc	0	0
Socio-Economics	PhD	1	0
	MSc	0	2
	BSc	1	0
Aquaculture engineering	PhD	0	0
	MSc	0	0
	BSc	0	1
Fish Breeding	PhD	2	0
	MSc	2	0
	BSc	1	0
Environment	PhD	0	0
	MSc	2	1
	BSc	0	1
Larval culture	PhD	1	0
	MSc	2	0
	BSc	0	0
Management of culture systems	PhD	0	0
	MSc	0	1
	BSc	0	0
Seaweed Culture	PhD	0	0
	MSc	0	0
	BSc	1	0
		17	9

Information and extension

Though private extension services play a significant role in information dissemination, public extension services continue to be the key source of information on farmers' new and emerging technologies (Engle, 2017; Kumar et al., 2018). In general, the extension service sector in Kenya is male-dominated. Van Stappen

et al. (2020) reported that there are more male extension officers (82.1%) and limited number of female extension officers (17.9%). In a gender impact study, Farm Africa (2016) reported that the capacities of fisheries extension officers from the county governments on gender are relatively low and of significant concern. The study also reported that cases of a few women requesting access to female experts, since this would enable them to freely share and learn more about the art, social and science of fish farming. This is could be somehow linked to cultural norms that limit women from interacting with male extension workers. Manfre et al. (2013) report that there is a myriad of challenges to recruiting and retaining women extension officers including but not limited cultural restrictions hindering their mobility and /or interaction with men. Further Kiumbuku, Mutinda and Bernard (2013) highlight an emerging trend of equal access to extension services between men and women fish farmers in Trans Nzoia County, indicating an improvement in policy. However, the degree of involvement, participation and benefits vary between households and counties that warrants further research. In a gender impact study, Farm Africa (2016) reported that the capacities of fisheries extension officers from the county governments on gender are relatively low and of significant concern. The study also reported that a few women requested access to female experts, since this would enable them to freely share and learn more about the art, social and science of fish farming. Again, this is somehow linked to cultural norms that limit women from interacting with male extension workers.

Challenges facing women participating in fish farming

In Kenya, women fish farmers have less access to finances, markets, low literacy levels and production inputs such as land and ponds compared to the male counterparts (Obiero et al., 2019). Similarly, gender norms and discriminatory policies inhibit their rights and limit their opportunities to benefit from aquaculture (Ndanga et al., 2013). According to Farm Africa (2016) for women to be involved in commercial aquaculture, women will need sufficient technical skills and know-how, capacity building, suitable timing for

women (given their other home duties and tasks), practical lessons where they will be able to learn by doing and providing women trainers who can relate with women farmers. Insufficient labor and time are the prominent challenges that women in aquaculture endure (Farm Africa, 2016) but women have to work within that limitation to fit in within aquaculture activities. Land tenure systems in Kenya have led to more men owning land and control of farming activities to be carried out in the piece of land. Though women's right to land and/or property are clear and protected under the Kenyan Constitution of 2010 and in various national statutes, women still remain disadvantaged and discriminated against. Such discriminations are due to customary laws and practices that continue to bar them from inheriting or owning land and/or other property forms. The customary practices in Kenya grant women secondary land rights making them unable to inherit land in their own right (Musangi, 2017). Though women have access to utilize land, they possess insufficient powers to make critical decisions on aquaculture activities, and this limits their access to formal credit (Ndanga et al., 2013). These challenges are equally present in the agricultural sector (Me-Nsope and Larkins, 2015). Having assets and command over them is vital for a fruitful engagement from aquaculture production (CGIAR, 2017; FAO, 2017a; FAO, 2017b). It also enhances impartial intrahousehold decision-making and aids in poverty eradication (Johnson et al., 2016). The inability to have authority over resources and assets deters women from selecting how to use them as valuable inputs or allocation to other uses. In Kenya, the distribution of assets is gendered, with women being disadvantaged in terms of control of assets and ownership. This poses a restraint to livelihood improvement, socioeconomic development and food and nutritional security as it backpedals women, those of whom are more than half of Kenya's population that is a vital production means (KPHC, 2019).

Approaches for reshaping aquaculture and enabling women to have equality and empowerment to increase aquaculture production in Kenya and areas of further research

Mechanisms for reshaping the extent of women's participation and advantages from all facets of aquaculture exists. However, the inadequacy of sufficient and quality context-specific data is one reason women cannot be seen in aquaculture policy (Williams et al., 2002). Sex-disaggregated data in aquaculture should be collected and disseminated to the general public and used consistently in aquaculture planning and development and in designing practical and appropriate policies and interventions (Farm Africa, 2016). Obiero et al. (2019) have elucidated preference and needs for fish seed and breeding programs, feeds and their associated impacts. The most user responsive and promising technologies that can result in increased profit margins are complete commercial feeds, sex-reversed fingerlings and value-addition methods. Inclusion of all stakeholders in the nature of data to collect is equally crucial. Research-based critical analyses of gender inequality with transformative solutions will need to be documented.

With the aquaculture boom, dynamic analysis in the relationship between women's empowerment and aquaculture intensification is beginning to be of high priority. Approaches to overcome limitations to wealth generation for women and gender-inclusive and women-led entrepreneurship and agribusinesses models should be developed and implemented (Kruijssen et al., 2018). Experiences of successful women entrepreneurs in aquaculture should be documented to foster enthusiasm amongst other women. These should be in user-friendly and accessible sites. Platforms like social media are ideal for promoting women's successes in aquaculture to the wider public both within and outside the subsector (Brugere and Williams, 2017). Women should also form national groups and or associations to communicate their predicaments in a structured way. These can be heightened to the national level where they can establish regional women aquaculture associations. In India, some women have become aquaculture entrepreneurs either with help or single-handedly (Shanthi et al. 2010). More studies documenting how and when women can prosper are however, necessary.

In Kenya, food-insecure people are occasionally susceptible to malnutrition, with women of productive age and children being more at risk (Obiero et al., 2019). The inclusion of a nutritional component in aquaculture interventions

is promising for increasing household incomes, empowering women and improving food and nutrition security. The nutritional element (Thilsted et al., 2012) entails culturing small nutrition-rich species, culturing home use and commercial species, improving nutrition information and eating behaviours and patterns (Brugere and Williams, 2017). This would result in better nutrition outcomes for women and their children (Malapit et al., 2015).

Women have to gain mastery over their significant influence by society on what they should or should not do. In that regard, household members should be capacity built on the nature of the work. They should be urged to lower the burden of workload and local support network groups need to be more gender-aware and knowledgeable regarding aquaculture. Therefore, integration of inclusion, gender and empowerment in research is crucial.

Conclusions and recommendations

Heightened evidence indicates that gender equity will help contribute to the attainment of SDGs on food and nutrition security, gender equality, inclusive and sustainable economic growth and poverty reduction. More specifically, gender equity in aquaculture can improve household incomes and enhance higher productivity and positive nutritional outcomes. The present study shows that women's role in aquaculture development is invisible and advocacy is needed to raise the gender profile. Bridging the gender gap would enable women to have more resources at their disposal and strengthen them within the household, a proven mechanism for enhancing children's health and education and food and nutrition security. Healthy children are more productive and the benefits would span generations in the future. Given the right policies, like applying gender-responsive and affirmative action strategies within the entire aquaculture value chain, and by following a well-coordinated multi-stakeholder approach, there can be progress and significant benefits in the sub-sector. The challenges that women in the various nodes of the aquaculture value chain face such as limited access to productive resources and start-

up capital, limited mobility, inadequate access to information and technology (training) and discriminatory customary laws and practices, to mention but a few, are substantial reasons for social justice. By addressing these, gender mainstreaming in legislative and policy frameworks of aquaculture development and associated or related sectors can be improved.

Acknowledgements

The author is very thankful to Dr. Mary Opiyo for her assistance and useful suggestions that significantly improved the manuscript.

Funding

The conference presentation of this work was supported by Kenya Marine and Fisheries Research Institute (KMFRI).

References

- Amankwah, A., Quagraine, K.K., Preckel P.V., 2018. Impact of aquaculture feed technology on fish income and poverty in Kenya. *Aquacult. Econ. Manag.* 1–21.
- Auwor, F. J., Obiero, K., Munguti, J., Oginga, J. O., Kyule, D., Opiyo, M. A., and Ochiewo, J., 2019. Market Linkages and Distribution Channels of Cultured, Captured and Imported Fish in Kenya. *Aquaculture Studies* 19(1), 57-67.
- Birgen, N., 2019. Building a Strategic Framework for Aquaculture Education in Kenya. Masters Dissertation. Ghent University, Belgium.
- Brugere, C. and Williams, M., 2017. Profile: Women in Aquaculture. <https://genderaquafish.org/portfolio/women-in-aquaculture>
- CGIAR Research Program on Fish Agri-Food Systems, 2017. CGIAR Research Program on Fish Agri-Food Systems (FISH): Gender Strategy. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Strategy: FISH-2017-13.
- Chete OB1, 2019. Gender and agricultural practice in developing countries: Literature review. *South Asian Journal of Social Studies and Economics* 5(2),1-11
- Dolan, C., 2001. The 'good wife': struggles over resources in the Kenyan horticultural sector. *Journal of development studies* 37(3), 39-70.
- Engle, C.R., 2017. The case for effective public funding of aquaculture research and extension. *J. World Aquacult. Soc.* 48, 851–853.

- Farm Africa, 2016. Gender Impact Study of the Kenya Market-Led Aquaculture Program. <https://www.farmafrica.org/downloads/resources/farm-africas-kmap-gender-impact-study.pdf>.
- FAO, 2017. Regional review on status and trends in aquaculture development in sub-Saharan Africa - 2015. FAO, Fisheries and Aquaculture Circular No. 1135/4, Rome, Italy.
- FAO, 2017a. Food and agriculture – driving action across the 2030 Agenda for Sustainable Development. Rome.
- FAO, 2017b. Report of the Sixteenth session of the COFI Sub-Committee on Fish Trade, Busan, Republic of Korea, 4–8 September 2017. FAO Fisheries and Aquaculture Report No. 1216, Rome.
- FAO, 2018. Agriculture Organization of the United Nations. 2016. The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. FAO, Rome.
- Felsing, M., Brugere, C., Kusakabe, K. and Kelkar, G., 2000. Women for aquaculture or aquaculture for women? *Infofish International*, No. 3/2000, pp. 34–40.
- Githukia, C. M., Drexler, S. S., Obiero, K. O., Nyawanda, B. O., Achieng'Odhiambo, J., Chesoli, J. W., and Manyala, J. O., 2020. Gender roles and constraints in the aquaculture value chain in Western Kenya. *African Journal of Agricultural Research* 16(5), 732–745.
- Goss, J., Burch, D., and Rickson, R. E., 2000. Agri-food restructuring and third world transnationals: Thailand, the CP Group and the global shrimp industry. *World Development* 28(3), 513–530.
- Johnson, N. L., Kovarik, C., Meinzen-Dick, R., Njuki, J., and Quisumbing, A., 2016. Gender, assets, and agricultural development: Lessons from eight projects. *World Development* 83, 295–311.
- KIT, Royal Tropical Institute, Agri-ProFocus and [IIRR] International Institute of Rural Reconstruction, 2012[KIT] Royal Tropical Institute, Agri-ProFocus and [IIRR] In. Challenging Chains to Change: Gender Equity in Agricultural Value Chain Development. KIT Publishers, Royal Tropical Institute, Amsterdam. https://www.kit.nl/gender/wp-content/uploads/publications/2008_chachacha.pdf.
- Kiumbuku, S., Mutinda, J., and Bernard, J., 2013. Forms of Gender Inequalities in Fish Farming in Kwnza Division, Trans Nzoia County, Kenya.
- KPHC, 2019. Kenya Population and Housing Census. Volume I: Population by County and Sub-County, Kenya National Bureau of Statistics. November, 2019. Nairobi, Kenya.
- Kruijssen, F., McDougall, C. L., and van Asseldonk, I. J., 2018. Gender and aquaculture value chains: A review of key issues and implications for research. *Aquaculture* 493, 328–337.
- Kumar, G, Engle, C, Tucker C., 2018. Factors driving aquaculture technology adoption. *J. World Aquacult Soc.* 49, 447–476.
- Lwenya CA, Lwenya KR, Abila R, Omwenga R (2006). Gender participation in Fisheries Management in Lake Victoria, Kenya. Kenya Marine and Fisheries Research Institute. <http://oceans.org/bitstream/1834/3570/1/WLCK-266-272>. Accessed January 20, 2020
- Malapit, H. J. L., Kadiyala, S., Quisumbing, A. R., Cunningham, K., and Tyagi, P., 2015. Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal. *The Journal of Development Studies* 51(8), 1097–1123.
- Manfre, C., Rubin, D., Allen, A., Summerfield, G., Colverson, K., Akeredolu, M., 2013. Reducing the gender gap in agricultural extension and advisory services: How to find the best fit for men and women farmers. Meas Brief, 2.
- Me-Nsope N, Larkins, M, 2015. Gender analysis of the pigeon pea value chain: Case study of Malawi. Center Report Series, No. 4. Global Center for Food Systems Innovation, Michigan State University, East Lansing, Michigan, USA. ISBN: 978-0-9903005-5-7
- Musangi, P., 2017. Women land and property rights in Kenya. In: Economic and Social Rights Centre-Hakijamii, Nairobi, Kenya. Paper prepared for presentation at the 2017 World Bank Conference on Land and Poverty. The World Bank, Washington DC.
- Ndanga, L. Z., Quagraine, K. K., and Dennis, J. H., 2013. Economically feasible options for increased women participation in Kenyan aquaculture value chain. *Aquaculture* 414, 183–190.
- Ngoc, P.T.A., Meuwissen, M.P.M., Le, T.C., Bosma, R.H., Verreth, J., Lansink, A.O., 2016. Adoption of recirculating aquaculture systems in large pangasius farms: a choice experiment. *Aquaculture* 460, 90–97.
- Ngugi, C., and Manyala, J., 2009. Assessment of national aquaculture policies and programmes in Kenya. Sustainable Aquaculture Research Networks in Sub Saharan Africa, Kenya.
- Obiero, K. O., Opiyo, M. A., Munguti, J. M., Orina, P. S., Kyule, D., Yongo, E., and Charo-Karisa, H., 2014. Consumer preference and marketing of Farmed Nile Tilapia (*Oreochromis niloticus*) and African Catfish (*Clarias gariepinus*) in Kenya: case study of Kirinyaga and Vihiga Counties. *International Journal of Fisheries and Aquatic Studies*, 1(5), 67–76.
- Obiero, K., Cai, J., Abila, R., Ajayi, O., 2019. Kenya: High aquaculture growth needed to improve food security and nutrition. World Aquaculture Production Indicators (WAPI) Policy Brief, FAO, Rome, Italy

- Obwanga, B., Lewo, M. R., Bolman, B. C., and van der Heijden, P. G. M., 2017. From aid to responsible trade: driving competitive aquaculture sector development in Kenya: Quick scan of robustness, reliability and resilience of the aquaculture sector (No. 2017-092 3R Kenya). Wageningen University and Research. The Netherlands.
- Ole-Moiyoi LK (2017) Fishing for answers: can aquaculture transform food security in rural Kenya? PhD Dissertation. Stanford University, Stanford.
- Schumacher, K. P., 2014. Gender relations in global agri-food value chains—a review. *DIE ERDE—Journal of the Geographical Society of Berlin*, 145(3), 127-134.
- Shanthi, B., Krishnan, M., Shandrasekaran, V.S. and Ponniah, A.G., 2010. Successful women entrepreneurs in aquaculture sectors: Case studies of Tamil Nadu, India. CIBA e-publication Series No. 20. Central Institute of Brackish Aquaculture, Chennai.
- Shirajee, S. S., Salehin, M. M., and Ahmed, N., 2010. The changing face of women for small-scale aquaculture development in rural Bangladesh. *Aquaculture Asia Magazine*, 15(2), 9-16.
- Thilsted, A. H., Bazargan, V., Piggott, N., Measday, V., and Stoeber, B. (2012). Flow manipulation and cell immobilization for biochemical applications using thermally responsive fluids. *Biomicrofluidics*, 6(4), 041101. <https://doi.org/10.1063/1.4768905>
- Van Stappen, G., Nyonje, B., Opiyo, M., Pynoo, B., Obiero, K. and Awuor, J.F., (Eds.), 2020. Aquaculture Labour Market and Education Programs Analysis in Kenya. A report for TEAM Project: Building a Strategic Framework for Aquaculture Education in Kenya, KMFRI, Kenya.
- Veliu, A., Gessese, N., Ragasa, C., and Okali, C., 2009. Gender analysis of aquaculture value chain in Northeast Vietnam and Nigeria. Agriculture and Rural Development Discussion Paper 44. The World Bank, Washington, D.C
- Weeratunge, N., Snyder, K. A., and Sze, C. P., 2010. Gleaner, fisher, trader, processor: understanding gendered employment in fisheries and aquaculture. *Fish and Fisheries*, 11(4), 405-420.
- Weeratunge-Starkloff Nireka and Jharendu, P., 2011. Gender and aquaculture: Sharing the benefits equitably. The WorldFish Center, Penang, Malaysia. Issues Brief 2011-32.
- Williams, M. J., Chao, N. H., Choo, P. S., Matics, K., Nandeesh, M. C., Shariff, M., and Wong, J. M. C., 2002. Global Symposium on Women in Fisheries: Sixth Asian Fisheries Forum, 29 November 2001, Kaohsiung, Taiwan (Vol. 1663). WorldFish.
- World Bank, 2007. Zambia Poverty and Vulnerability Assessment. Report No. 32573-ZM. Human Development I, Poverty Reduction and Economic Management I, Africa Region. World Bank, Washington, D.C.