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The status of women's empowerment in the aquaculture sector in Kenya

Rahma Isaack Adam
Social and Economic Inclusion Unit, WorldFish, Nairobi, Kenya
Farha Deba Sufian
Kingston Upon Thames, Kingston, UK, and
Lucy Njogu
Social and Economic Inclusion Unit, WorldFish, Nairobi, Kenya

Abstract

Purpose – Women's empowerment remains a key development challenge in Kenya. The purpose of this study is to attempt to understand the status of women's empowerment and the key contributors to their disempowerment in Kenya's aquaculture sector.

Design/methodology/approach – A cross-sectional survey was conducted on 534 male and female fish farmers from 300 households drawn from six counties in Kenya (Kakamega, Kisumu, Kisii, Kiambu, Meru and Nyeri). The Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) was adapted to Abbreviated Women's Empowerment in Fisheries and Aquaculture Index (A-WEFI) to suit the aquaculture and fisheries sub-sector. The adapted A-WEFI was then used to estimate and the status of women's and men's using five domains of empowerment (5DE) and a gender parity index (GPI). Data were analysed using descriptive statistics, Cramer's V and sensitivity analysis as test statistics.

Findings – About 86% of the men and 80% of the women were classified as empowered. The mean score of the 5DE was 0.93 and 0.95 for women and men, respectively. In addition, 82% of the households achieved gender parity, suggesting that for such households, empowerment of men was no greater than that of women. Overall, the results suggest no major differences between the empowerment of women and men. Findings suggest areas of improvement in empowerment: when observed separately, women report lack of agency in production, resource, time-use and allocation and leadership.

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Since submission of this article, the following author has updated their affiliation: Farha Deba Sufian is at Social and Economic Inclusion Unit, WorldFish, Nairobi, Kenya.

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Originality/value – This paper adapts the A-WEAI to the fisheries and aquaculture context, in bid to bridge the gap in standard women's empowerment measurement methods in this area. Also, there are limited empirical studies on the multifaceted empowerment of women in aquaculture in Kenya. The findings are meant to serve as a point of reference for policymakers, as they develop gender-responsive intervention programmes, and in implementing gender mainstreaming in Kenya.

Keywords Women's empowerment, Gender equality, Aquaculture, Kenya, Agency

Paper type Research paper

1. Introduction

Gender equality and women's empowerment are crucial in realizing women's rights (Dahal *et al.*, 2022; Guthridge *et al.*, 2022) and achieving economic development, especially through agriculture in developing countries (Alkire *et al.*, 2013; Bonis-Profumo *et al.*, 2021; Fischer and Qaim, 2012; Johnson *et al.*, 2018; Meinzen-Dick *et al.*, 2019; Smith *et al.*, 2003). Increased participation of women in fisheries and aquaculture leads to increased empowerment for women, and increased productivity and income in this sector (Barman and Little, 2006; E-Jahan *et al.*, 2010; St. Louis and Oliveira, 2022; Mikhailovich *et al.*, 2023). In Chiloé Island in southern Chile, for example, incorporation of labour from women and youth in the salmon industry was a major driver towards expansion of the industry (Ramírez and Ruben, 2015). Shirajee *et al.* (2010) noted that participation of women in aquaculture in Bangladesh resulted in improved socio-economic well-being among women, within the household and in the community in general. In addition, Torre *et al.* (2019) found that increased participation of women in fisheries activities and processes in Mexico increased their empowerment. Literature shows that whilst women participate in all the segments of the aquaculture and fish value chain, they are, however, not well represented in policy and research (Bosma *et al.*, 2019; Kruijssen *et al.*, 2018). For example, Freeman and Svels (2022) noted that although women play a vital role in survival of small-scale fisheries through innovation and development of new markets, male fishers are often registered as the main beneficiaries and actors in the sector. Overall, existing literature indicates that women's empowerment in fisheries and aquaculture is yet to be achieved, but also that global efforts are ongoing to improve women's participation and visibility in fisheries and aquaculture (Choudhury *et al.*, 2017; Freeman and Svels, 2022; Kruijssen *et al.*, 2018; Rajaratnam *et al.*, 2016) and other sectors (WEF, 2022).

The fisheries and aquaculture sector have received a lot of attention at national and international levels. For instance, between 2010 and 2013, the Government of Kenya invested KES 22bn (about US$0.22bn) through the Economic Stimulus Programme – Fish Farming Enterprise Productivity Programme to promote small-scale fish farming in Kenya. This resulted in 48,000 new smallholder fishponds by the end of the programme (Munguti *et al.*, 2022; Obwanga *et al.*, 2017). In developing countries, where aquaculture still has unexploited potential and fisheries remain crucial for food security, employment and income (Ogello and Munguti, 2016), the sector provides an opportunity for overall development and, importantly, women's empowerment.

Furthermore, the importance of the sector is projected to increase in tandem with the continued rapid growth in incomes, urbanization and population. At the same time, other food sectors have been significantly affected by climate change, considerably reducing yield. Currently, aquaculture is the fastest-growing food sector worldwide (Githukia *et al.*, 2020; Obiero *et al.*, 2019). Increased calls and efforts for women's empowerment in the overall fisheries and aquaculture sector require that adequate methods and measures of assessing women's empowerment be identified or developed.

2. Development of women's empowerment indices

Various approaches towards measuring women's empowerment have been adopted to understand the status and to benchmark progress towards attaining Sustainable Development Goal 5. At the global and national levels, there are commonly used measurement, such as the gender development index (GDI) which measures inequality based on differences in health, knowledge and standard of living (Bartůsková and Kubelková, 2014). However, the GDI does not take into consideration other critical gender indicators, including decision-making, which would be more representative of women's ability to make choices, nor community gender values (Asaolu *et al.*, 2018; Kabeer, 1999). The global gender gap index (GGGI) which was introduced by the World Economic Forum is critical in developing comparable empowerment indicators. It uses four dimensions:

(1) economic participation and opportunity;

(2) educational attainment;

(3) health; and

(4) survival and political empowerment (Charmes *et al.*, 2023; Choe *et al.*, 2017).

However, the GGGI does not indicate context-based dimensions of agency, such as time-use balance. The gender empowerment measure (GEM) assesses gender inequalities based on political and economic opportunities (Branisa *et al.*, 2009). GEM puts all countries of comparison on the same ladder by using income levels instead of income percentages or proportions. This exaggerates the picture of disempowerment for women in low-income countries, even where the gender income gaps may be minimal (Choe *et al.*, 2017).

The gender inequality index (GII) uses three dimensions to measure the lost human development: reproductive health, political empowerment and economic status (Amin and Sabermahani, 2017). Though GII was developed in response to some of limitations in the GDI and GEM (Amin and Sabermahani, 2017), it has been criticized for mixing well-being (health) with empowerment (political representation and education). The index has also been criticized for leaving out the informal economy when estimating the earned-income indicator, and for excluding important gender-inequality dimensions, such as the unpaid work done by women, differences in wages, gender-based violence, representation of women in local government and gender asset gaps (Bartůsková and Kubelková, 2014; Berik, 2022). Another commonly used indicator is the Social Institutions and Gender Index (SIGI), which was developed by the Organization for Economic Co-operation and Development and constructed around legal and social institutions (Branisa *et al.*, 2014). SIGI is made up of five sub-indicators: discriminatory family code, restricted physical integrity, son bias, restricted resources and assets and restricted civil liberties. These sub-indicators provide insight into the gender-inequitable social institutions reflected by legal norms and societal practices (Cerise and Francavilla, 2012). Though SIGI plays a crucial role – especially in assessing the direction towards gender equality and women's empowerment at national and global levels – it does not present individual-level empowerment outcomes (Alkire *et al.*, 2013). Major setbacks of the indicators include omission of critical gender-equality and women's empowerment dimensions, inapplicability at individual level and poor choice of indicators and variables (Amin and Sabermahani, 2017; Bartůsková and Kubelková, 2014; Berik, 2022; Charmes *et al.*, 2023; Ferrant *et al.*, 2020). These limitations partially emanate from lack of a standard definition of women's empowerment (Kabeer, 1999). Secondly, the indices are mostly developed for specific applications, but due to lack of suitable measures of women's empowerment, researchers tend to adopt them for a wide range of uses.

In fisheries and aquaculture, varying approaches have been used to measure women's empowerment (Azmi *et al.*, 2021; Farquhar *et al.*, 2017; Huq *et al.*, 2016; Shashank *et al.*, 2018).

For instance, Freeman and Svels (2022) conceptualized women's empowerment as a composite of resources/pre-conditions, agency/process and outcomes/achievements. A similar approach was adopted by Haqiqiansyah and Sugiharto (2018), who conceptualized empowerment as "power with", "power to" and "power within". Though these studies used a similar basis to define women's empowerment, the indicators for each category of empowerment were different, making it impossible to compare the empowerment in the two areas of study. In some cases, researchers develop scales for their own studies without validation, creating an erroneous picture of women's empowerment in fisheries and aquaculture (Meetei *et al.*, 2016; Rahman, 2005) Other studies focus on a small aspect of empowerment, such as participation, which is inadequate for demonstrating the level of women's empowerment in aquaculture (Shah and Bukhari, 2019).

Owing to these limitations, and the lack of a comprehensive index to painstakingly analyse gender equality and women's empowerment in the overall agricultural sector as well as in fisheries and aquaculture, the women's empowerment in agriculture index (WEAI) was developed, from which the women's empowerment in fisheries and aquaculture index (WEFI) was adapted (Quisumbing *et al.*, 2023). Adapting WEAI to WEFI and its various derivatives to different agricultural sub-sectors has proven not only useful but also crucial in measuring women's empowerment (Cole *et al.*, 2018, 2020; Ragsdale *et al.*, 2022). As summed up by Quisumbing *et al.* (2023), before development of WEAI and its derivatives, most measures of women's empowerment in agriculture and its sub-sectors focused on measuring a limited aspect of agency and empowerment, or were indirect, in that they only focused on measuring women's access to economic resources.

The project-based Women's Empowerment in Agriculture (pro-WEAI) and Abbreviated Women Empowerment in Agriculture (A-WEAI) were later derived from the initial WEAI for project impact evaluations and resource-limited studies, respectively (Alkire *et al.*, 2013; Malapit *et al.*, 2019; Ragsdale *et al.*, 2022). In this study, an Abbreviated Women's Empowerment in Fisheries and Aquaculture Index (A-WEFI) is adapted from A-WEAI. Just like A-WEAI, A-WEFI is shorter and more streamlined, hence appropriate for resource- and time-limited projects. Another similarity to A-WEAI is that A-WEFI can allow statistical comparability over time, and across countries and social groups (Malapit *et al.*, 2015a, 2015b). The index adopts Kabeer's definition of women's empowerment as a process of change, whereby women expand their ability to make strategic life choices that had previously been denied to them (Kabeer, 1999). These choices include resources, agency and achievements, which all contribute to women's empowerment. By being designed accordingly, the A-WEFI tool can help identify impediments to women's agency and interventions.

Against this background, we analyse the status of women's empowerment in Kenya's aquaculture sector. We contribute to the literature of empowerment in aquaculture by using a novel women's empowerment analysis method: The A-WEFI. To our best of knowledge, this is the first time A-WEFI has been analysed in this manner in general, and in Kenya, in particular. Specifically, we determine how gender equity, for instance, in decision-making in productive activities, asset ownership and gender attitudes, among other indicators of women's economic and social empowerment, is different and/or similar for women and men. We believe this body of work will help to fill the knowledge gap on women's empowerment in the aquaculture sector, particularly in Kenya.

The rest of the paper is structured as follows: Section 3 describes the methodology on data collection and sampling, and the framework used for data analysis. Section 4 presents the findings which cover demographic characteristics of respondents and women's empowerment level compared with men in the aquaculture sector. Findings are followed by discussion, where we go into detail on what our findings mean, and lessons learned from the study. The final section is on conclusions.

3. Methodology

3.1 Study population, survey instrument and sampling procedure

3.1.1 Study population and survey development. A survey was carried out to collect quantitative data in Kenya using structured questionnaires from September to November 2022. The study targeted 300 fish-farming households in six counties: Kakamega, Kisii and Kisumu in western Kenya and Kiambu, Meru and Nyeri in central Kenya. The survey tool was designed by adopting and where necessary modifying the publicly available WorldFish's A-WEFI survey. The questionnaires were then programmed into electronic format in Survey to go-PC surveyor that supported data collection through smartphone devices. The tool was then translated to Kiswahili – a commonly used language in Kenya – to ensure questions were similarly understood by all respondents in the survey sample. The translated questionnaires were double-checked first by translators then by a third party (i.e. other than the translator) to ensure that the intended meaning of the questions was retained/maintained in the Kiswahili. This was achieved by first translating all survey instruments into Kiswahili, then back-translating them into English to ensure that the words retain the correct meaning. A pilot study was conducted in Kakamega county among 10% of the total sample population to validate the questionnaire, improve the survey quality and to ensure that all relevant information was included. Farmers interviewed during the piloting were not included in the main study.

3.1.2 Sampling procedure and data collection. Step I – county sample: a multi-stage sampling method was adopted. In the first stage, the six counties (Kakamega, Kiambu, Kisii, Kisumu, Meru and Nyeri) were purposively selected because they are identified as high aquaculture production areas within the regions (Ogello and Munguti, 2016). Most of the women in these counties are directly or indirectly engaged in aquaculture. This continuum, therefore, presents different scenarios to comprehensively investigate the level of women's empowerment. A list on estimated number of active fish farmers was provided by county representatives from the Fisheries Department of Kenya's Ministry of Agriculture and Livestock. This list guided the proportionate distribution of the survey sample (see Appendix: Table A1) according to the distribution of number of households involved in aquaculture conducted by the Kenya Population and Housing Census (KNBS, 2019). The final sample size was 534 farmers comprising 258 men and 276 women derived from 300 households.

Step II – sampling of sub-counties: in consultation with the representatives from each county's fisheries department, the survey team obtained a list of active fish farmers which was used to purposively identify 29 sub-counties for the survey sample. In each sub-county, wards where fish farming is commonly practised were purposively selected based on information obtained from the county department of fisheries. Sub-counties where the sample was drawn from are in the Appendix, Table A2.

Step III – enumeration areas (EAs) sampling: within the selected wards, a list of farmers was used to randomly draw survey households. The field supervisor and sub-county fisheries officers jointly identified clusters within a ward that had fish farmers. The clusters were designated as EAs and a maximum target of ten farmers allocated to each EA. In each EA, lead farmers were identified with assistance from fisheries officers. The lead farmers guided the identification of farmers with active ponds in the EA.

Step IV – interviewing: the interviews were conducted by trained enumerators who spoke English and the local languages in the sampling area. All enumerators attended mandatory A-WEFI + enumerator training workshop prior to commencing data collection. The training workshops were led by the WorldFish team in Kenya. WorldFish experts reviewed the final questionnaire for validity and reliability. The lead farmers and enumeration team scheduled interview appointments with the fish farmers. The selected

farmers were sensitized on the objectives of the survey, the estimated length of interview, the need for paired interviewing for spouses and solicitation of informed consent from study subjects. Within the selected households, target respondents included the primary respondent, defined as the main fish producer and the secondary respondent who ideally was the spouse of the primary respondent. Single-respondent interviews were conducted in households where the primary respondent did not have a spouse i.e. widows/widowers, separated or single primary respondents. In some areas, the list obtained from the fisheries department had some farmers whose ponds had been inactive for more than two years at the time of the survey. They were excluded from the survey. Where the list of farmers provided could not yield an adequate sample, additional lists of farmers were sourced from different sub-counties. This was the case in Kiambu and Nyeri. For example, Gatundu North was added to the original list of sub-counties where a few other farmers were sampled from within villages that cut across sub-counties.

3.1.3 Data analysis. Data were transferred from the questionnaires to Excel. The unit of identification was the individual respondent. Data were then disaggregated by gender to compare responses from women and men. Descriptive statistics such as mean, percentage and frequency were used for description. Test statistics used were Cramer's V and sensitivity analysis.

3.2 Framework for data analysis

3.2.1 A-WEFI domains and indicators. In this study, we developed A-WEFI to aid in examination of the level and status of empowerment of women and men engaged in fisheries and aquaculture. We adopted a multidimensional approach to measuring the agency, empowerment and inclusion of women in fisheries and aquaculture contexts in an effort to identify ways to overcome those obstacles and constraints. The A-WEFI is an aggregate index based on individual-level data from primary female and primary male decision-makers within the same households. It draws its methodological foundation from the A-WEAI, which is a survey-based index designed to measure the agency, empowerment and inclusion of women in the agricultural area (Malapit *et al.*, 2020). A-WEFI builds upon the validated A-WEAI (Malapit *et al.*, 2020), which has a strong focus on crops, by incorporating scenarios, resources and activities that specifically apply to households that engage in fisheries and aquaculture.

Like A-WEAI, A-WEFI is generated as a weighted average of two sub-indices:

(1) the five domains of empowerment (5DE) score; and

(2) the gender parity index (GPI).

The 5DE sub-index measures the extent of individuals' engagement in fisheries and aquaculture in five areas:

(1) decisions over production;

(2) access to and decision-making power over productive resources;

(3) control over use of income;

(4) time-use; and

(5) leadership.

It measures the degree to which women are empowered in these domains, and for those who are not empowered, the percentage of domains in which they are empowered. Following Alkire *et al.* (2013), the 5DE index was computed using the formula in equation (1):

$$5DE = 1 - M_0, \tag{1}$$

where M_0 denotes disempowerment index:

$$M_0 = H_p \ X \ A_p \tag{2}$$

Hp is disempowered headcount ratio computed as:

$$H_P = \frac{d}{N} \tag{3}$$

d and N are the number of disempowered individuals and the total population, respectively. The second component, A_p, is the average inadequacy score of disempowered individuals:

$$A_P = \frac{\sum_{i=1}^{n} C_i(k)}{d}, \tag{4}$$

where $C_i(k)$ is the censored inadequacy score of the i^{th} individual and d is as defined earlier. The 5DE index ranges from 0 to 1. Higher values (0.8 and above) signify empowerment (Malapit *et al.*, 2017; Alkire *et al.*, 2013).

On the other hand, GPI was calculated using the following formula in equation (5):

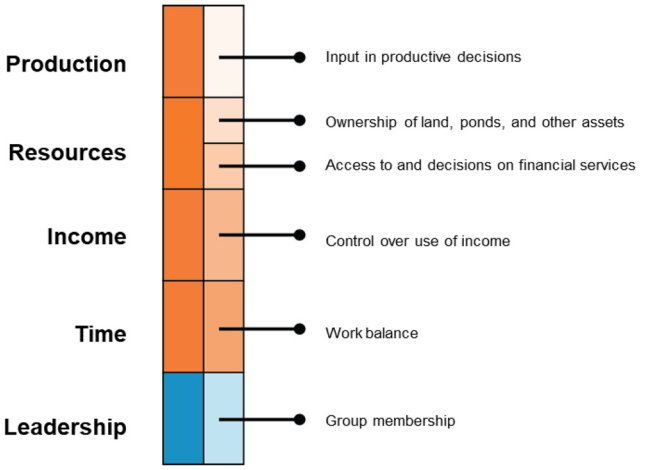
$$GPI = (1 - P1) = 1 - (H_w \ X \ I_P) = H_p + H_w \ X \ R_p, \tag{5}$$

where H_p is the percentage of women with gender parity, H_w is the percentage of women without gender parity, I_p is the women's average empowerment gap relative to men (for women who live in non-parity households), R_P is the women's relative parity score; $H_p + H_w = 1, I_p + R_p = 1$. A household has parity if either the woman is empowered or if a disempowered woman has an adequacy score greater than that of the man (Gupta *et al.*, 2017).

Figure 1 summarizes the domains and corresponding indicators measured in A-WEFI.

Table 1 has definitions and adequacy cut-offs for each indicator used to calculate the final A-WEFI. Each indicator has several questions for interviewees. Finally, a weighted index is calculated using these six indicators, where each domain has an equal weight of 1/5 following the A-WEAI methodology.

To assess women's agency in the production domain, A-WEFI uses indicators of adequacy in "Input in productive decisions", examining respondents on their participation and extent of decision-making in fishing and post-fishing activities. Access to both productive and financial resources positively affect women's empowerment and agency in household decision-making (Wrigley-Asante, 2012). A-WEFI uses two indicators to identify women's adequacy in the resource domain. "Ownership of land and other assets" suggests adequacy of women in either securing sole or joint access to gleaning areas, or solely or jointly owning land, or a pond or at least three other productive assets that aid in activities pertaining to fisheries and aquaculture. The indicator "Access to and decisions on credit" assesses women's level of participation in household credit decisions, or their having access to at least one financial account. For adequacy in this indicator, one must belong to a household that has used a source of credit in the past year, and must have participated in at least one decision about it.



Source: McDougall *et al.* (2022)

Figure 1.
The domains and indicators of A-WEFI

Domain	Indicator(s)	Weight	Definition of adequacy
Production	Input in productive decisions	1/5	An individual meets at least ONE of the following conditions for ALL of the agricultural, aquaculture and fisheries activities they participate in 1. Makes related decision on their own 2. Makes the decision jointly and has at least some input into the decisions 3. Feels could make decision if wanted to (to at least a MEDIUM extent)
Resources	Ownership of land and other assets	2/15	An individual owns, either solely or jointly, at least ONE of the following: 1. At least THREE assets 2. Land or pond 3. Gleaning area (access)
	Access to and decisions on credit	1/15	An individual meets at least ONE of the following conditions: 1. Belongs to a household that used a source of credit in the past year AND participated in at least ONE sole or joint decision about it 2. Belongs to a household that did not use credit in the past year but could have if wanted to from at least ONE source 3. Has access, solely or jointly, to a financial account
Income	Control over use of income	1/5	An individual has control over income if there is AT LEAST ONE activity in which the individual has some input in decisions about income generated, or feels she/he can make decisions regarding wage, employment and major household expenditures
Time	Work balance	1/5	An individual works less than 10.5 h per day: Work balance = time spent in primary activity + (1/2) time spent in childcare as a secondary activity
Leadership	Group membership	1/5	An individual is an active member of at least ONE group

Table 1.
A-WEFI indicator definitions of adequacy

The third domain in A-WEFI uses an indicator of adequacy in having "Control over income". This indicator determines whether women have some input in decisions regarding income from fisheries, wages, employment or any major household expenditure. Because women play an active and important role in household food and nutrition decisions, in assessing their overall empowerment, it is imperative to determine women's control over income (Kawarazuka and Béné, 2010). A-WEFI incorporates women's work balance using a detailed 24-h time-allocation module in which respondents are asked to recall the time spent on primary activities in the 24 h prior to the interview, starting at 4:00 a.m. on the day before the interview. Although a 24-h recall does not adequately represent time allocation, especially in an agricultural society, recall of time allocation longer than 24 h generally has higher recall error (Malapit *et al.*, 2020). Borrowing from A-WEAI, we define an individual as achieving "work balance" if the number of h he or she allocated to productive or domestic activities per day was less than the time poverty line of 10.5 h in the previous 24 h. Finally, A-WEFI uses an indicator of active membership in any groups in their community to determine women's potential for leadership and influence in their community, i.e. the fifth domain of leadership.

3.2.2 Index construction. Using the adequacy cut-offs discussed Sub-section 3.2.1, six binary variables are generated, with one signifying adequacy in the indicator and 0 the opposite. Consequently, using equal weights of 1/5 for each of the five domains, a weighted sum of all indicator variables is computed to generate the individual empowerment scores, which range from 0 to 1. Higher values indicate more empowerment. The A-WEFI methodology uses an empowerment cut-off point of 0.8, such that a respondent is classified as empowered if their weighted empowerment score is equal to or above 0.8, i.e. she is empowered in roughly four out of the five domains, following A-WEAI (Malapit *et al.*, 2020). The individual empowerment scores of are then aggregated to construct the 5DE index, which considers both the number of women who are disempowered and the intensity of their disempowerment (Abebe *et al.*, 2016). Further details on how the individual indicators and empowerment scores are combined to form the 5DE score are in the Instructional Guide on the A-WEAI (Malapit *et al.*, 2020). The final A-WEFI score is composed of the weighted sum of two sub-indices: 5DE and GPI, where 5DE has a weight of 90% and GPI 10%, placing greater emphasis on 5DE while still recognizing the importance of gender equality as an aspect of empowerment (Alkire *et al.*, 2013). The GPI in the case of A-WEFI compares the empowerment scores of men and women in fisheries and aquaculture in the same household.

3.2.3 Two versions of index. Data collection methods used in development of other empowerment indices, such as WEAI or A-WEAI, following Alkire *et al.* (2013) recommend asking the respondents about their time-use from 4:00 a.m. of the previous day of the survey to 4:00 a.m. of the current day in 15-min intervals to determine their time-use. Respondents are first asked to state when they woke up and went to bed the previous day. Activities for the day are then recorded slot by slot for the interval between waking and sleeping. In this study, however, time-use data were collected by activity rather than time intervals. From an exhaustive list of 27 domestic, productive and leisure activities, respondents were asked to state in which hours of the day they performed activity 1 through 27. This difference in data collection method yielded multiple activities recorded for the same time interval in various cases, which led to total time in a day exceeding 24 h for many respondents. Such results are expected, as women in fisheries generally engage more in multitasking (Nabayunga *et al.*, 2021). This was also observed in our data: in our sample, we found more cases of total time in a day exceeding 24 h for women than for men. We address this methodological difference in data collection by creating two versions of A-WEFI, and comparing the results for both versions. Table 2 shows the domains, indicators and weights used in both versions:

(1) *Version 1 (V1)*: The first version of A-WEFI is created using the methodology described earlier in Table 1. We use all five domains and six indicators to calculate this version of A-WEFI. Because time spent in a day varies from 24 h for several respondents, we address this in two steps. Firstly, we excluded time spent in childcare from the total time, as it is accounted for separately in the "work balance" indicator calculation (Malapit *et al.*, 2020). Thereafter, observations that still added up to more than 24 h were set to missing. However, we included observations which reported total time spent being less than 24 h, as setting them to missing would significantly reduce the sample size. Thus, the final sample for *V1* drops from 276 women and 258 men to 209 and 236, respectively.

(2) *Version 2 (V2)*: We created another version for the A-WEFI by excluding work balance, i.e. the time domain, as an empowerment indicator. This version excludes work balance in the calculation, and re-evaluates weights for the remaining indicators for consistency by assigning equal weight to all domains, in keeping with the A-WEAI methodology. Therefore, in *V2*, all domains had an equal weight of 1/4.

In the findings section which follows, we explore in detail the sensitivity and effect of excluding the work balance indicator in empowerment scores and headcounts.

4. Findings

4.1 Demographic characteristics of respondents

Table 3 presents key demographic characteristics of the final sample of men ($n = 258$) and women ($n = 276$) who responded to the A-WEFI questionnaire. Nearly all sample households had both male and female adults, with only 6% of the women belonging to female-adult-only households. Most women in the sample were in two main age categories: 42% were 26–45 years and 45% were 46–65 years. Half of the men in the sample were aged 46–65, with only 25% in the younger age category of 26–45 years.

More than half the women (57%) in the sample completed secondary school, while 5% never attended school. Half (50%) the men completed secondary school while 23% had post-secondary education. Almost all women and men in the sample identified themselves as Christian. At the time of the survey, 85% of women and 97% of men were married. Nearly all women (100%) and men (94%) in the sample belonged to dual-adult households.

4.2 Women's empowerment level compared with men in aquaculture

This section describes the key results on empowerment of men and women using two versions of the A-WEFI methodology discussed in Section 3. We use a cut-off of 0.80 on a scale of 0 to 1 to categorize respondents as empowered if they achieved a weighted score

Domain indicator(s)		Weight	
		V1	*V2*
Production	Input in productive decisions	1/5	1/4
Resources	Ownership of land and other assets	2/15	1/6
	Access to financial services	1/15	1/12
Income	Control over use of income	1/5	1/4
Time	Work balance	1/5	Not included
Leadership	Group membership	1/5	1/4

Table 2. Indicator weights used for two versions of A-WEFI

Variable	% of respondents Women ($n = 276$)	Men ($n = 258$)
Age group		
16–25	5	5
26–45	42	25
46–65	45	50
>65	8	20
Education		
Never attended school	5	2
Primary	27	26
Secondary	57	50
Post-secondary	11	23
Marital status		
Never married	3	3
Married	85	97
Cohabitation	6	0
Divorced/separated/widowed	6	0
Religion		
Christianity	100	98.5
Islam	0	1.5
Household type		
Dual-adult household	94	100
Female-adult-only household	6	0

Table 3. Sample characteristics of respondents by gender ($N = 534$)

above or equal to the cut-off (Alkire *et al.*, 2012). With *V1*, the final sample of non-missing observations for men and women were 236 and 209, respectively, while *V2* had higher number of both men (258) and women (276) due to the exclusion of "time" domain from the final index construction. Table 4 reports the overall A-WEFI, its sub-indices and 5DE and GPI for the sample of men and women drawn from all six study counties.

Overall, A-WEFI for women was 0.93 in V1, which is a weighted average of the 5DE sub-index value of 0.926 and the GPI sub-index value of 0.959. The 5DE for women in V1 shows that 80% of the sampled women and 85% of men were found to be empowered, suggesting that they had individual scores equal to or higher than the adequacy cut-off of 0.8, in keeping with A-WEAI. For women, 20% of those not empowered have – on average – inadequate achievements in 38% of the domains, i.e. the mean disempowerment score for not-yet-empowered women. Thus, the women's disempowerment score (1 – 5DE) is found to be 19.6% × 37.9% = 0.07, yielding a 5DE score of 0.93. Furthermore, nearly 82% of the women achieved gender parity, suggesting that only 18% of the women had lower scores than the primary male respondent from the same household.

Results from V2 suggest that compared to V1, the headcount and overall scores vary: slightly for women, and more for men. With work balance excluded as an indicator of empowerment, in V1, 75% of the men are empowered compared to 86%. The 5DE score in V2 is also lower, at 0.90 compared to V1's 0.95. The variation in the results is indicative of the importance and sensitivity of "time" as an empowerment domain, especially for individuals in fisheries and aquaculture. To understand the variation, we first observe the percentage contribution of each indicator to the overall disempowerment score of the sampled men and women in this study.

Indicator	Version 1 (V1) Women	Men	Version 2 (V2) Women	Men
Number of observations	209	236	276	258
5DE score	0.93	0.95	0.91	0.90
Disempowerment score (1 – 5DE)	0.07	0.05	0.09	0.10
Percentage achieving empowerment	0.80	0.86	0.75	0.70
Percentage not achieving empowerment	0.20	0.14	0.25	0.30
Mean 5DE score for not yet empowered	0.62	0.62	0.64	0.67
Mean disempowerment score (1 – 5DE) for not-yet-empowered women	0.38	0.38	0.36	0.33
Gender parity index (GPI)	0.96		0.95	
Number of dual-adult households	236		258	
Percentage achieving gender parity	0.82		0.80	
Percentage not achieving gender parity	0.18		0.20	
Average empowerment gap	0.23		0.23	
A-WEFI score	0.93		0.91	

Table 4.
A-WEFI results

Table 5 shows the percentage contribution of each indicator to the total disempowerment score of men and women. We examine the contributions for the two versions separately, with V1 having six final indicators and V2 five. Using both methods, we find that the top two contributors to disempowerment for both men and women in the sample are inadequacy in having "input in productive decisions" and lack of "membership in groups". Intriguingly, 18% of the disempowerment score (1 − 5DE) of women is attributed to inadequacy in achieving work balance, while the same only applies to 8% of the men in the sample. Furthermore, contribution of work balance to total disempowerment of men in V1 may aid in explaining why we observe a 16% reduction of empowered men when we exclude work balance in the calculation of the composite index in V2. Work balance contributes least to the overall disempowerment of men in the sample, indicating that most men worked less than 10.5 h per day. Exclusion of the least contributing indicator for men led to an increase in the mean disempowerment score for men from 0.05 to 0.1 (Table 6). Thus, the percentage of men who were classified as empowered in V1 also reduced significantly, lowering the 5DE score for men using V2.

Table 6 presents the uncensored and censored headcount ratios of inadequacy for all indicators in the A-WEFI score. As discussed earlier, inadequacy is when a respondent fails to meet the adequacy criterion set for each indicator in Table 1. Censored headcount of inadequacy for an indicator shows the proportion of sampled women who were found inadequate in that indicator and classified as disempowered overall, i.e. with an overall score

	V1 Proportional contribution to disempowerment (%)		V2 Proportional contribution to disempowerment (%)	
	Women	Men	Women	Men
Input in productive decisions	32.2	31.1	45.6	39.8
Ownership of land and other assets	9.4	16.4	8.8	19.4
Access to and decisions on financial services	9.4	11.5	6.1	11.7
Control over use of income	9.0	11.5	8.1	6.8
Work balance	18.0	8.2		
Group membership	21.9	21.3	31.4	22.3

Table 5.
Relative contributions of each indicator to disempowerment

below 0.8. Conversely, uncensored headcount shows the percentage of respondents who are inadequate in an indicator, regardless of their overall empowerment status. It is important to note the role played by sample size in the results we observe. While V1 considers headcount for adequacy in each indicator for a total of 209 women, V2 considers 276 women. The uncensored headcount ratio for both men and women under both methods remains mostly comparable, with slight differences arising from the difference in the final sample size. Results from uncensored headcounts reveal that on all the A-WEFI indicators, the highest proportion of both men and women in the sample reported inadequacy in having access to credit, or in making decisions on credit. This is intriguing because as shown in Table 5, access to credit is not a top contributor to disempowerment. This puzzle can be solved by looking at results from censored headcounts. As stated earlier, censored headcounts represent the percentage of women who are disempowered overall and are inadequate in a particular indicator. The censored headcount for access to credit for both men and women reduces dramatically compared to the uncensored headcount. This suggests that most disempowered respondents have adequacy in access to credit.

Next, we looked at the intrahousehold patterns of empowerment for the men and women from dual-adult households in the sample by comparing the adequacy scores of men and women within these households. We defined adequacy as the proportion of indicators in which the respondent is adequate. As before, we have two sets of results from V1 and V2. We found that the adequacy score of men was higher than that of the women in 36% of the dual-adult households (V1, Table 7). Intriguingly, in 34% of the households, women had higher scores than men, while the remaining 31% had equal scores for men and women.

Figure 2 shows the intrahousehold patterns of empowerment in the dual-adult households in our sample by comparing headcounts between men and women. Nearly three-quarters (70%) of dual-adult households in the sample constituted of empowered women and men living in the same household, while only 11% of the households had empowered women only. The distribution of intrahousehold empowerment changes when moving from

Table 6. Headcount ratios of inadequacy in A-WEFI indicators

	Version 1 (V1)				Version (V2)			
	Uncensored headcount (ratio%)		Censored headcount (ratio%)		Uncensored headcount (ratio%)		Censored headcount (ratio%)	
	Women	Men	Women	Men	Women	Men	Women	Men
Input in productive decisions	19.14	16.53	11.96	8.05	16.30	15.89	16.30	15.89
Ownership of land and other assets	9.57	20.34	5.26	6.36	9.42	18.60	4.71	11.63
Access to and decisions on financial services	21.05	26.27	10.53	8.90	21.74	24.81	6.52	13.95
Control over use of income	3.35	2.97	3.35	2.97	2.90	2.71	2.90	2.71
Work balance	13.40	8.90	6.70	2.12	–	–	–	–
Group membership	13.40	8.90	8.13	5.51	11.23	8.91	11.23	8.91

Table 7. Intrahousehold patterns of empowerment

	% of dual-adult households	
	V1	V2
Adequacy score of men > Adequacy score of women	35.4	32.5
Adequacy score of women > Adequacy score of men	33.6	31.3
Adequacy score of women = Adequacy score of men	31.0	36.2

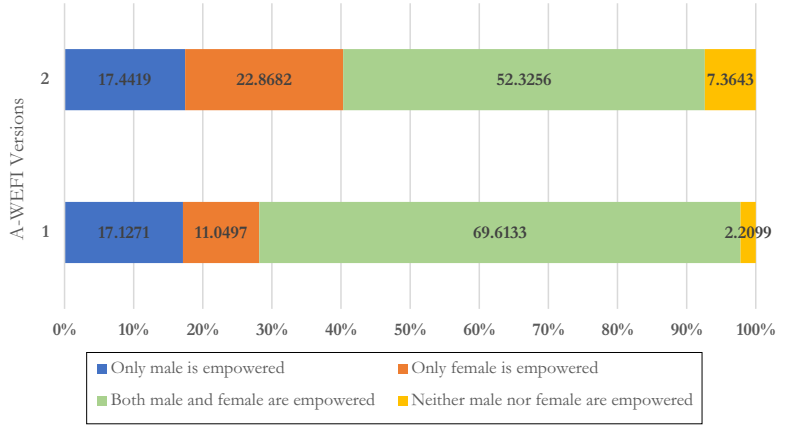


Figure 2. Intrahousehold patterns of empowerment in dual -adult households

six to five indicators. The percentage of households where both men and women were found empowered was 17% lower for V2 compared to V1. Similarly, the percentage of households where neither men nor women were empowered is relatively higher in V2. Interestingly, households where only the woman was empowered increased by 12%. We observe this increase as being mainly due to exclusion of work balance, which in turn suggests that women have low adequacy in achieving work balance, which, when removed, increased the overall headcount of empowered women in the sample.

4.3 Robustness tests

4.3.1 Association analysis. We next assessed the level of associations between the individual indicators that form the composite index, A-WEFI. Such a diagnosis is important to unearth high correlations between the indicators, which, if not addressed, can impose a higher weight on the paired indicator than intended. Table 8 present the Cramer's V correlation coefficients for each pair of indicators that yield the first version of A-WEFI, i.e. with work balance included.

We find weak correlation between all possible pairs, with all Cramer's V coefficients well below 0.3. This reinforces the importance of five varied domains in the methodology, as each contributes to determining different facets of women's agency in the productive sphere, particularly in fisheries and aquaculture. Work balance, which furthermore requires refinement in future research, also has very weak correlations with the other indicators. It

	Input in productive decisions	Ownership of land and other assets	Access to and decisions on credit	Control over use of income	Work balance	Group membership
Input in productive decisions	1.000					
Ownership of land and other assets	0.032	1.000				
Access to and decisions on credit	0.044	0.129	1.000			
Control over use of income	0.253	0.138	0.171	1.000		
Work balance	0.006	−0.090	−0.045	0.060	1.000	
Group membership	0.062	0.150	0.056	0.019	−0.101	1.000

Table 8. Association (Cramer's V) between six A-WEFI indicators

therefore makes important contributions in depicting the inadequacy stemming from high workload, as fishing and post-fishing activities can be labour-intensive (Birhanu, 2015). Finally, we also find weak pairwise correlations among indicators when restricted to the five indicators that form V2 of the index (Table 9).

4.3.2 Sensitivity analysis (rank robustness). We assessed the sensitivity of the A-WEFI results to the time domain using the rank robustness analysis by Alkire *et al.* (2015). We achieved this by observing A-WEFI results separately for each of the six counties in the sample, then ranking the counties *by the percentage of disempowered individuals*, i.e. the proportion of the sample with adequacy scores below 0.8, using the two versions of A-WEFI.

Results from Table 10 show that ranking of counties remains unchanged for the sampled men in both versions. However, the ranking of counties changes considerably for women in the sample for the two methodologies used, implying the sensitivity of women's overall empowerment to the inclusion of work balance as an indicator of agency. Such results help reinforce our methodological deviation in creating two versions of the index to extract as much information from the sample as possible, to help refinement of the index in future research.

5. Discussion

Although difficult to measure, the role of women's empowerment and agency in the productive areas is indisputably imperative for high scores on welfare indicators, including reduction of malnutrition, increase of agricultural productivity, increase in household income and promoting education (Alkire *et al.*, 2013; Bonis-Profumo *et al.*, 2021; Johnson *et al.*, 2018; Smith *et al.*, 2003). Because fish is the fastest-growing food sector worldwide, understanding the role and agency of women in fisheries and aquaculture is extremely vital. Fish is a sustainable source of rural income and a predominant source of protein in

Table 9. Association (Cramer's V) between five A-WEFI indicators

	Input in productive decisions	Ownership of land and other assets	Access to and decisions on financial services	Control over use of income	Group membership
Input in productive decisions	1.000				
Ownership of land and other assets	0.046	1.000			
Access to and decisions on credit	0.025	0.113	1.000		
Control over use of income	0.265	0.129	0.148	1.000	
Group membership	0.056	0.153	0.066	0.018	1.000

Table 10. Sensitivity of headcounts to domains and indicators

	Ranking (percentage not achieving empowerment)			
	Women		Men	
County	V1	V2	V1	V2
Kakamega	1	3	2	2
Kiambu	3	2	3	3
Kisii	2	1	6	6
Kisumu	6	6	1	1
Nyeri	4	5	4	4
Meru	5	4	5	5

developing countries (Aura *et al.*, 2018; Mirera *et al.*, 2014; Subasinghe *et al.*, 2009). Although most of the rural women contribute significantly to aquaculture as many remain at home, their contribution is perceived as an extension of their domestic role and is therefore neither recognized nor compensated (Githukia *et al.*, 2020). Yet the role of women in aquaculture is spread throughout the value chain, including production, distribution and marketing, significantly contributing to development (Githukia *et al.*, 2020). Therefore, empowering women by augmenting their decision-making and involvement in household aquaculture production is crucial. Designing targeted effective interventions to increase women's empowerment entails assessing the extent of their agency. Thus, in this study, we surveyed men and women in western and central Kenya from households engaged in aquaculture to assess the status of women's empowerment relative to men in the aquaculture sector, and the key contributors to their disempowerment. We relied on the A-WEFI methodology to measure empowerment indices.

Using a final sample of 276 women and 258 men, we find that nearly 86% of men and 80% of women were classified as empowered, i.e. with an individual score equal to or above 0.8, with 1 as the highest score. The mean 5DE score was 0.93 and 0.95 for women and men, respectively. In addition, 82% of the households achieved gender parity, suggesting empowerment of men was no greater than that of women for such households. The average A-WEFI score for the sample was 0.93. Although indices at a single point in time cannot give us the full empowerment picture, the indicative results from this study may seem quite high. One reason for the high score is rooted in the selection bias of the sample. As mentioned earlier, the counties chosen for this study were purposively selected because they are identified as high aquaculture production areas within the selected regions. Therefore, the survey included men and women already engaged in aquaculture, and who were available for the survey. Thus, the average empowerment status of such respondents is likely to be high, as reflected in our findings. Moreover, the A-WEFI relies on six indicators, which is half of the full 12 WEFI indicators. In pilot samples, this loss of information leads to slightly higher rates of empowerment among women. Similarly, high empowerment and/or disempowerment values of men and/or women (lack of accurate representation of the true data) are also reported in other studies that measure empowerment, e.g. Malapit *et al.* (2020) from A-WEAI studies on Bangladesh and Uganda.

From the findings, using V1, work balance contributes largely to overall disempowerment of women in the sample. In addition, work balance has weak correlations with other indicators. This supports the importance of its inclusion in the overall empowerment, because the workload in fishing and post-fishing activities remains high, which is likely to disempower women if its score goes beyond a certain threshold. This study also found that the assessment of percentage of disempowered women was highly sensitive to inclusion of the time indicator. All these findings make the business case for further research for better measures of time-use by using more efficient data collection methods to determine the workload of men and women in fisheries and aquaculture.

Results also revealed that nearly half of the women in the sample (46%) reported having very little input in productive decisions, including decisions related to fisheries and aquaculture (Figure A1, Appendix). Studies on women's empowerment and agency have shown the two factors as having positive impacts on both household economic (Bayeh, 2016) and nutritional well-being (Heckert *et al.*, 2019; Malapit *et al.*, 2015b). Therefore, the lack of input in household decisions that we observed for the women in the sample is alarming and needs attention to increase engagement of women in productive activities and decisions. Thus, A-WEFI can help to unearth and diagnose the obstacles facing women in fisheries

and aquaculture, and inform the design of better programmes where remedial changes are necessary.

One key attribute of the A-WEFI methodology is the decomposability of its composite index into disempowerment domains and sub-domains. This versatile granularity enables identifying the leading sources of disempowerment facing women in fisheries and aquaculture. Intriguingly, headcount analysis of inadequacy in individual indicators of A-WEFI reveals that nearly a fifth of the women in the sample lacked access to credit, or had very little input in household credit decisions. In addition, nearly 13% were not active members of any group, and 19% reported lacking input in household productive decision-making, including aquaculture decisions. Moreover, 13% of women reported working more than 10.5 h a day, suggesting lack of work balance, and most likely their heavy involvement in care work. However, this figure may not be wholly reliable due to the measurement/data-collection limitation of the time-use module of the A-WEFI questionnaire.

5. Conclusion

This study sought to adapt A-WEAI into fisheries and aquaculture to build on the measures of women's empowerment and gender equality. We also sought to build on the existing literature on women's empowerment and agency in aquaculture in East Africa by applying the adapted tool in Kenya. We used the A-WEFI to assess women's empowerment in aquaculture. Firstly, we find that the A-WEFI is an ideal and comprehensive tool for measuring women's empowerment in aquaculture. The findings of various domains coincide with existing literature. However, we note that the index is highly data-sensitive and requires adequate training of enumerators. It is critically important that the time-use data collected not exceed 24 h by accordingly programming the data collection tool. Also, computer-assisted personal interviews (CAPI) programming and field application of the time-use indicator both require proper training. In addition, and to minimize errors in data collection, it is necessary that enumerators and researchers have a shared understanding of the analysis process, and intended use of the data from this segment. Regarding the state of women's empowerment, we did not find major differences between women and men in our sample, though we found areas needing improvement in empowerment, because when observed separately, women report lack of agency in production, resources, time and leadership. Based on the current findings, future initiatives in this area of study should consider and address the extent of the empowerment gap identified here. The reduction of disempowerment and facilitation of appropriate empowerment in all aspects will be achieved by improving the contribution of each indicator – according to its importance – to the disempowerment of both men and women.

Going forward, we recommend validation and further use of the A-WEFI across different countries for undisputed reliability of the findings in policy development. Furthermore, we recommend that for research to determine agency, empowerment and inclusion of women in the aquaculture and fisheries sector(s), where resources are available, the full WEFI or project-level WEFI should be used to comprehensively guide programme or project directions. This would enable accurate identification of target areas to fully realize women's potential in, and to fully optimize their benefits from, the aquaculture and or fisheries sector. By replicating the A-WEFI in aquaculture value chain participants in additional counties in Kenya, important insights would also be gained on gender equality similarities and variations across sites/contexts.

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Appendix

Figure A1. Percentage contribution of indicators to disempowerment (V2)

County	Estimated fish farming households (*N*)	Sampled households (*n*)
Kisumu	783	35
Kakamega	2,223	60
Kisii	810	25
Meru	1,089	60
Nyeri	760	60
Kiambu	417	60
Total sample	6,082	300

Source: KNBS (2019)

Table A1. Survey sample distribution per county

County	Sub-county	County	Sub-county
Meru	Imenti North	Kisii	Sameta
	Igembe South		Nyamache
	Igembe North		Marani
	Tigania East		Kisii South
	Tigania Central	Kisumu	Kisumu East
Kakamega	Khwisero		Kisumu Central
	Kakamega East		Nyando
	Kakamega Central	Nyeri	Tetu
Kiambu	Gatundu North		Nyeri Central
	Kiambu		Kieni East
	Thika East		Kieni West
	Lari		Nyeri South
	Githunguri		Mathira East
	Gatundu South		Mukurwe-ini
	Githunguri		

Table A2. List of Sub-counties sampled

About the authors

Rahma Isaack Adam is a gender scientist at WorldFish. She has over a decade years of work experience in gender, agriculture and international development research and practice. She holds a Bachelor of Arts degree in Biology and minor in Anthropology from Macalester College, USA, a Master of Public Policy degree from the Harvard University, USA and a PhD degree in Rural Sociology from Pennsylvania State University, USA. She has conducted research in Eastern, Southern and West African countries, Asia and USA. Rahma Isaack Adam is the corresponding author and can be contacted at: R.Adam@cgiar.org

Farha Deba Sufian is an international development specialist with eight years of research experience. She has worked with several CGIAR research centres across the globe in data analytics and capacity-building for research in women's empowerment in agriculture index in the Global South. She has a Master of Arts in Economics from Simon Fraser University. She has a Bachelor of Business Administration from North South University.

Lucy Njogu is a researcher in gender and market in agri-food systems. She is currently pursuing her PhD in development studies at University of East Anglia. She has a Masters in Agricultural Economics from Kenyatta University and a Bachelor's degree in Agribusiness Management from Egerton University.