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EMPOWERMENT PROFILES IN RURAL
EGYPT WITH A PARTICULAR FOCUS ON WOMEN

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Working Paper No. 1198

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Abstract

The current study examines the extent of empowerment for different types of women in Egypt's Old and New Lands (Noubariya and Kafr Shiekh). Empowerment in this study is multidimensional and is referring to access and management of capital, time and assets, with a particular focus on land. Research conducted in the past three decades in Latin America, India, and sub-Saharan Africa shows that land access empowers women in their ability to produce food, to participate in public life, as well as in household decision-making. However, relatively little is known about the relations between women, land and empowerment in the Middle East. Some 402 farmers (200 men and 202 women) were surveyed in both locations in Egypt, focusing on tasks within the farm, in addition to ownership and control over the main resources including land and livestock. A set of data including variables reflecting different empowerment dimensions of the surveyed farmers was collected in the study areas, and used for clustering homogeneous groups (men and women) with similar empowerment profiles. Characteristics of these men and women groups were then reported in order to provide better insights regarding empowerment gaps which might be used to develop targeted policy intervention strengthening certain empowerment aspects for these groups.

JEL Classifications: B54, B55

Keywords: Women's Empowerment, Clustering, Egypt, Land Access, Agriculture, Policies.

ملخص

تبحث الدراسة الحالية مدى التمكين لنماذج مختلفة من النساء في أراضي قديمة وجديدة (النوبارية وكفر الشيخ) في مصر. إن التمكين في هذه الدراسة متعدد الأبعاد وهو يشير إلى حصول النساء على رأس المال والوقت والأصول وإدارتها، مع التركيز بشكل خاص على الأرض. تظهر الأبحاث التي أجريت في العقود الثلاثة الماضية في أمريكا اللاتينية والهند وأفريقيا جنوب الصحراء الكبرى إلى أن الوصول إلى الأراضي يمكن المرأة بما يعزز من قدرتها على إنتاج الغذاء، والمشاركة في الحياة العامة، وكذلك في صنع القرارات الأسرية. ومع ذلك، لا يعرف إلا القليل نسبياً عن العلاقات بين المرأة والأرض والتمكين في الشرق الأوسط. فقد تم مسح حوالي 402 مزارع (200 رجل و202 امرأة) في كلا الموقعين القديمين والجديدين في مصر، مع التركيز على المهام داخل المزرعة، بالإضافة إلى الملكية والسيطرة على الموارد الرئيسية بما في ذلك الأرض والثروة الحيوانية. وتم جمع مجموعة من البيانات بما في ذلك المتغيرات التي تعكس أبعاد التمكين المختلفة للمزارعين الذين شملهم الاستطلاع في مناطق الدراسة، واستخدمت الدراسة تلك البيانات لتجميع مجموعات متجانسة (من الرجال والنساء) مع ملفات التمكين المماثلة. وتم الإبلاغ بعد ذلك عن خصائص هذه المجموعات من الرجال والنساء من أجل تقديم رؤى أفضل فيما يتعلق بفجوات التمكين التي يمكن استخدامها لوضع سياسة للتدخل تستهدف تعزيز بعض جوانب التمكين لهذه المجموعات.

1. Introduction

It is well-documented that women's empowerment is context-dependent (Alkire et al. 2013; Carr et al., 1996). Yet, most gender indices measure empowerment at the aggregate level focusing on education, participation in wage employment in the non-agricultural sector, and women's share in national parliaments with limited differentiation for important factors such as age, regions, and economic sectors (Alkire et al. 2013). In rural areas agriculture is the dominant employer of the population and especially so for Egyptian women. Agriculture in Egypt employs 43% of women vs. 24% of men between 2011 and 2014 (World Bank 2017). Yet, women in Egypt constitute only 5% of the agricultural landowners (FAO 2017). Women in rural Egypt are also largely excluded from agricultural extension (or training). For example, a study conducted by the FAO on women and agriculture in Egypt reported that "only 3 out of 6,497 participants in on-farm research between 1987 and 1993 were women; there was only one woman among 745 participants in field days; and no women among the 129 participants in residential training" (FAO 1993). According to the same study, only 12% of women had access to loans, mainly through agricultural credit companies rather than agricultural banks. El-Tobshy (2005: 127-128) confirms Egyptian women's limited access to extension services and credit. She attributes the limited access to extension services for women to a lack of women extension agents and low access to credit to the lack of women property ownership, which could act as collateral. Although small credit is accessible to the landless, large amounts of credit beyond 6,000 EGP is only accessible to those who own land.

As a result, it is important to consider empowering women in rural Egypt, especially in relation to their ability to access resources, including information, land, and credit. In the specialized literature, the "Women's Empowerment in Agriculture Index" is pioneering in its attempt to measure control over resources and agency in the agricultural sector. Land, in particular, is a promising route for women's empowerment. In her book "A Field of One's Own", Agarwal (1994) pioneered linking women's empowerment with land rights. Through land access, she argues, women can gain status, participate in public life, and overcome oppressive patriarchal structures.

In addition to the domains mentioned above, limited participation in public life also impedes women in their ability to contribute to growth and development in the agricultural sector (Najjar 2015). Heavy workloads or time constraints are also a major impeding factor (Alkire et al. 2013). This study is based on the premise that empowerment is multidimensional, thus women's empowerment in the agricultural sector should target multiple domains. At the same time, effective women's empowerment policies need to be well targeted. Standard empowerment policies proposing blanket interventions and recommendations for different empowerment cases usually fail to account for the diversity of women's needs and profiles. For each type of empowerment profiles, specific actions and policies need to be implemented in order to upgrade women's capacities and livelihoods.

As land remains among the most important empowerment assets, we thus consider special attention to women who own land and purposefully include them in our study. By including such women in our clustering, we can further identify their specific need in terms of other empowerment domains and also provide recommendations for other groups of women. Most of the research on women and land rights is focused on Latin America, South Asia, and Sub-Saharan Africa (Deere and Leon 2001; Agarwal 1994, 2003; Whitehead and Tsikata 2003; Walker 2003). In addition to offering perspectives from the Middle East which is largely marginalized from the debate on land rights for women, this study builds on the existing WEAI literature to provide an analytical framework that can identify empowerment topologies using a data-driven clustering approach.

This would have important implications on the effectiveness of empowerment programs and policy design. Based on this general objective, our work will specifically focus on:

1. Identifying a typology of farmers in rural Egypt based on a set of variables reflecting the five empowerment domains, and identifying the prospects and constraints for women's empowerment linked to each cluster;
2. Understanding the role of land status in the different empowerment profiles identified; and
3. Deriving key policy lessons that can be used to target specific gaps in the identified empowerment profiles.

Variables used in the clustering were carefully selected for inclusion in a survey administered to 402 farmers to reflect the five empowerment domains (see Table 5). In order to reach our research objectives, we examine empowerment profiles of women and men farmers in two areas of Kafr sheikh and Noubariya located in the New and Old Lands (Figure 1). The comparison between men and women empowerment profiles allows for a better understanding of gender gaps and inequalities. The study areas are chosen based on differences in socio-economic, gender norms and biophysical dynamics to cover as diverse women empowerment experiences as possible. Such diversity will enhance the robustness of our analysis and generates better representative results. While some women in Noubariya own land through a state-led land distribution scheme and are given rigorous training and ample microcredit support, women in Kafr Sheikh are increasingly managing farmland due to male out-migration and off-farm employment with relatively limited support from extension services and agricultural banks. Women there manage the land through renting or through farming in absence of a male head of household. Noubariya area in Egypt is of particular interest because 20% of landholders are women due to imposed aid conditionality by the "World Food Program" (food for resettlement) in a land distribution scheme called the "Mubarak Resettlement Scheme".

The paper starts by a literature review on women and empowerment in the Middle East with a focus on land. Then we move to describing the survey and case study areas as well as a description of the cluster analysis approach and respective variables selected. Following, the results of the clustering and discussion for the differing empowerment profiles will be presented. The report ends with policy implications and ways for moving forward.

2. Literature framework

Our analysis is based on the empowerment and agricultural productivity literature (Kilic, et al, 2015; Graeub et al., 2015; de la O Campos, et al, 2016; Mwesigye & Matsumoto, 2016; Medina, et al, 2015; Sraboni et al, 2014; Alkire et al. 2013; Molden et al 2010) with a particular focus on Agarwal's (1994, 2003) seminal work linking land rights and women's empowerment. For Agarwal land access provides women with a tool to obtain credit, skills, and information, be involved in public life, achieve food security, and thereby potentially overcome gender inequalities (Agarwal 1994, 2003). Walker (2003) argues that such adaptations of Agarwal's recommendations on women's access to land is needed for the varying contexts. In this study, we will provide a MENA perspective on the debate related to women's land rights.

In the past three decades, land and property ownership has been identified as an important component of gender equality (Datta 2006; Jackson 2003; Razavi 2007, 2009; Varley 2007; Agarwal 1994, 2003; FAO 2011). An FAO study in 2011 also suggests that providing women with equitable access to resources, including land, would decrease world hunger by up to 17% and increase world food production up to 4%. The Middle East remains largely marginalized from the

debate on land access for women and how this access can best lead to empowerment of women (Najjar 2013). Similarly, linking productivity to women's involvement and empowerment in agriculture has been a focus of research conducted in Sub-Saharan Africa and South Asia ((Wa Githinji et al., 2014; Kilic et al., 2015; Njuki et al., 2014; Doss and Morris, 2000), but similar studies were rarely undertaken in the MENA region.

Low property ownership rates for women in Egypt led the United Nations Economic Commission for Africa (UNECA) to describe the allowance of property ownership for women in Egypt as “lagging behind” and “alarmingly low” (UNECA 2007: 19). This is largely due to the customary system which mostly provides land to men as inheritance (Stuath 1990). Both scholars and practitioners have applied themselves to understanding how best to enable women, who currently own less than two percent of the world's landed property, to acquire these assets (see, for example, Agarwal, 1994; Baruah, 2010).

In addition to addressing the gaps in the literature listed above, most research about women and land rights in the Middle East is limited to inheritance (Moors 1996; Stuath 1990; FAO n.d.). Taken together, this study opens up new grounds to systemically understand the links among empowerment, women, and land access in Egypt for women who own land to women who rent land to women who farm the land in the presence of a male head of household. Although the study generates findings from Egypt linking women, land, agricultural productivity, and empowerment, it has broader relevance to the ‘patriarchal belt’ of the Middle East and North Africa region where similarly high rates of male outmigration and low rates of land ownership prevail (see for example Abdelali Martini et al. 2003). To assess women's empowerment profile in WEAI, we draw on the five main domains of this index.

Conceptually, the WEAI has five important domains which comprise of “production”, “resources”, “income”, “leadership” and “time”. In particular, the index examines decision-making power in terms of production, resource use, income expenditure, leadership and time expenditure (on work and leisure) (Alkire et al. 2013). We use these five domains for identifying clusters of women's empowerment profiles. We do not calculate the index by itself but we rather use different variables reflecting these domains to implement a cluster analysis (Goyeneche et al., 2014; Sarbu et al., 2012) in order to identify an empowerment typology of women and men farmers.

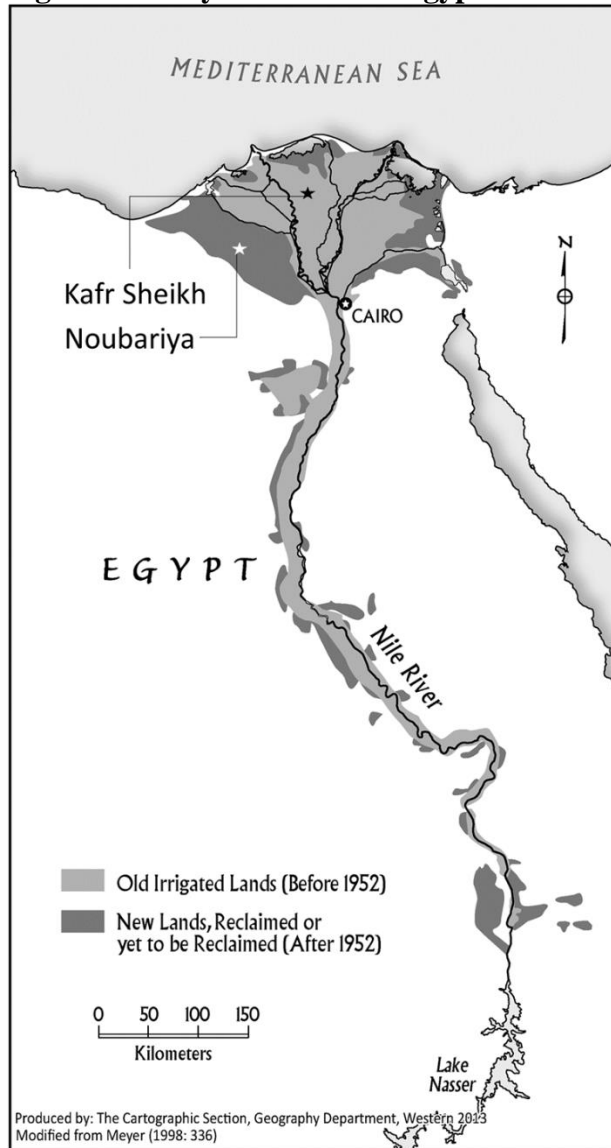
3. Methods and Study Areas

This section describes the case study areas and the methodology (standard factor analysis followed by a K-Mean Cluster Analysis) used to cluster empowerment groups.

3.1. Case Study Area and Survey

Our research sites are located in Noubariya in the “New Lands”, which are desert lands that have been brought into cultivation since the Revolution of 1952, and Sidi Salem in the “Old Lands”, which are areas cultivated since the inundation of the Nile (Figure 1). Noubariya is located in the Intilaq area which has been reclaimed in the 1990s under the Ministry of Agriculture and Land Reclamation. This area is of interest, since women received land and were invited for membership to farmers' organizations. Sidi Salem is located in Kafr el Sheikh area which is part of the “Old Lands” of Egypt. Old lands are part of the Egyptian delta that has been annually inundated by the Nile before the construction of the High Aswan Dam.

Figure 1. Study Locations in Egypt



Both study areas have strikingly different characteristics in terms of landownership rates for women, access to credit and participation on committees, technological endowment, and social control (gender roles) (Table 1). These different conditions change the situation of women who are working in and/or managing land.

Table 1. Factors shaping the situation of women in the two case study areas

<i>Region</i>	Intilaq area in Noubariya	Sidi Salem area in Kafr Sheikh
<i>Land Management</i>	High (Women owners of land at 20% rate)	High (women renters of land or farming in absence of a male head of household)
<i>Public participation and credit for women</i>	High participation in public life due to WFP and IFAD involvement High access to credit due to land ownership	Low participation in public life with limited development agencies' involvement Low access to credit and mostly limited to small amounts (less than 6000 EGP)
<i>Social Control of women</i>	Low social control over women's role due to high demand on labour. Nuclear families relocate into the New Lands have limited labour supply	High social control over women's roles due to entrenched norms
<i>Agricultural Technology</i>	Highly Mechanized	Less Mechanized

Source: Field observation and key informant interviews.

In addition to diversity of study locations as explained above, we ensured that survey data were collected from different types of respondents: women who independently own land in Noubariya; women who manage land in Kafr Sheikh; women who help in their husbands farm in Noubariya; women who help in their husbands farm in Kafr Sheikh; men who rent land in Noubariya; men who rent land in Kafr Sheikh; men who own land in Noubariya; men who own land in Kafr Sheikh. The purpose of such sampling approach was to cover as many different forms of ownership, use and access to land as possible that are present in both areas. A survey administered to 402 respondents (202 men and 200 women) (Table 2) provided the data used in the clustering.

Survey questions included the identification of: the person(s) responsible for decision-making related to selection of crops grown on the farm, to adopt innovations and to manage agricultural enterprises more broadly; the person(s) who own land and control it as well as other assets' ownership and control and access to credit services; the person(s) responsible for decision-making in relation to income expenditure and marketing; the level of participation of the respondent on committees and number of accomplishments on these committees; the number of hours spent by men and women on different tasks and the number of tasks done by men and women. In addition to this data, the incomes from major crop and livestock activities have also been collected. Survey questions were tested in the field and enumerators were trained on collecting the respective data before their field involvement. The survey was administered in 13 villages in Kafr Sheikh and 13 villages in Noubariya.

Table 2. Type of respondents and number of surveys

Type of respondents	Number of surveyed farmers
Women who own land in Noubariya	50
Women who manage land in Kafr Sheikh (may also be joint owners)	70
Women who help their husbands farm in Noubariya. Husbands may be owners or renters.	52
Women who help their husbands farm in Kafr Sheikh. Husbands may be owners or renters.	30
Men who own land in Kafr Sheikh	50
Men who rent land in Noubariya	50
Men who own land in Kafr Sheikh	50
Men who rent land in Noubariya	50

Farmers were randomly selected within each of the groups identified in Table 2. Yet the sample is structured through the type of land ownership and management, this does not affect the

representativeness of the empowerment profiles we are trying to identify. In fact, the profiles we are searching will be driven by the number and types of variables used to reflect each of the WEAI domains, and not by the number of specific types of farmers in each type of respondent groups (Table 2).

3.2 Clustering analysis

3.2.1 Principal component analysis (PCA) as pre-processor for clustering

The idea of principal component (PC) methods is to “summarize” a large data set (A with N individuals and K variables) into a smaller number of uncorrelated variables ($S < K$) (Sarbu et al., 2012). The principle is to reduce the number of variables N by generating a new dataset of continuous variables called ‘principal components’. The new components are supposed to retain the same information from of the original dataset. The first component describes most of the variation in the data; the second principal component is orthogonal and covers much of the remaining variation and so on (Keenan et al., 2012). The PCA remains one of the most important methods for detecting relational patterns between variables of different types, and identification of groups’ differences. Both continuous and dummy variables can be considered for a PCA. The generated components can then be used in different types of clustering, without worries about variables’ correlations. The K-hierarchical clustering method is used for our case.

3.2.2 Cluster analysis: the K-Mean method

Cluster analysis is a multivariate analysis technique used to sort individual observations into groups, based on homogenous set of variables (Frija et al. 2016). The clustering is usually performed based on principal components Analysis (PCA). PCA can be viewed as a de-noising method which separates signal and noise (the first dimensions extract the essential of the information while the last ones are restricted to noise). Without the noise in the data, the clustering is more stable than the one obtained from the original distances. Another good reason for the use of PCA is related to the combination of continuous and binary variables which the analyst may need to use for clustering. In presence of such combination, the distance between both types will not be generally accurate. It is thus better to perform the PCA in order to generate continuous aggregate variables based on the correlations of our initial variables.

Two main sub-divisions of clustering procedures can be found in the literature. In the first procedure the number of clusters is pre-defined. This is known as the K-Means Clustering method. When the number of the clusters is not predefined we use Hierarchical Cluster analysis. The K-Mean method was chosen in this study due to the large number of variables used and to the high size of the sample. With this method, the analyst keeps control over the total number of clusters which will be generated and which will be consistently defined through a set of statistical tests which should also be performed during the analysis. K-Mean Clustering uses a defined metric to form clusters sequentially; grouping the most similar objects first and these initial groups are then merged based to their similarities (Goyeneche *et al.*, 2014, in Frija et al., 2016). When the similarity between groups decreases, all groups are fused together into a single cluster (Keenan *et al.*, 2012).

In order to decide which observations (clusters) should be combined, appropriate metric (distance between pairs of observations) calculation methods have to be used. Different kinds of metrics (distance measures) can be used. The choice of the metric may influence clustering, since different methods can give different measures of distances between different pairs. In the K-Mean clustering, the similarity is computed using simple Euclidean distance. The Euclidian distance is the most common for clustering purposes, and it is simply defined as the length of the line

segment connecting two points (Corcoles *et al.*, 2010): $D = \sqrt{\sum_{i=1}^n (X_{ij} - X_{ik})^2}$; Where X_{ij} is the value of the indicator i of the sample j ; X_{ik} is the value of the indicator i of the sample k .

3.3 Application: variables used to generate empowerment clusters

A set of 27 variables reflecting main socioeconomic, demographic, and the main five domains of women empowerment attributes in the studied areas has been selected to conduct the empowerment typologies in the case study areas. The selection of appropriate variables for the clustering analysis is a key step in the typology process (Table 3).

For the production domain, variables reflecting empowerment domains included (see Table 3) the person(s) responsible for decision-making related to selection of crops grown on the farm, to adopt innovations and to manage agricultural enterprises more broadly. Variables reflecting the person(s) who own land and control it as well as other assets' ownership and control are considered as important themes for the resources domain. Access to credit services were also identified as variables for this domain. For the income domain, we included variables related to decision-making for income (generated from crops, meat, and milk) expenditure. For leadership domain, variables included participation on committees of farmers' organizations and number of accomplishments on these committees. For the time domain, the variables included are the number of hours spent on different tasks by men and women and the number of tasks done by men and women. Table 3 below provide a more detailed description of each of the variables used under each empowerment domains.

Table 3. Variables used in the clustering

<p><u>Socioeconomic and demographic variables</u></p> <ul style="list-style-type: none"> • Gender, • Head of household: expressing whether the respondent is the head of the household or not. • Age
<p><u>Empowerment in decision-making about agricultural production</u></p> <ul style="list-style-type: none"> • Contribution to decisions on management of crops production#: expressing whether women in the household is participating to management decisions for crops production • Contribution to decisions on management of livestock production# • Gross income generated from crop production • Gross income generated from meat production • Number of innovations that have entered the community and are relevant to men • Number of innovations that have entered the community and are relevant to women, • Number of innovations adopted by the respondent (men or women) • Number of innovations improved by the respondent (men or women)
<p><u>Empowerment in access to and decision-making power about productive resources</u></p> <ul style="list-style-type: none"> • Total land owned (in kirat²) in the household of the respondent • Land ownership by women# • Land control by women# • Total number of buffalo and cows owned • Total number of goat and sheep owned • Crop enterprise control by women# • Reliable access to credit by the respondent (men or women) • Obtained Credit: identify whether the respondent (men or women) had obtained credit in the last 3 years
<p><u>Empowerment in control of use of income</u></p> <ul style="list-style-type: none"> • Control* of crop income by women#: variable capturing whether women are controlling income from cop production or not. • Control of meat income by women# • Control of milk income by women#
<p><u>Empowerment in leadership in community</u></p> <ul style="list-style-type: none"> • Membership in local farmers associations • Number of accomplishments done in the associations in which they are members
<p><u>Empowerment in time allocation</u></p> <ul style="list-style-type: none"> • Total number of tasks in the farm carried out by women# • Percentages of agricultural tasks that are done by women more than men# • Total number of working hours for women# for the main crop in the region (rice in Kafr Sheikh and trees in Noubariya

(*): All the control variables apart from “control of livestock enterprise” are referring to who is able to sell the asset.

(#): All variables marked by this symbol refer to women’s involvement. Those which are not marked are referring to the involvement of the respondent.

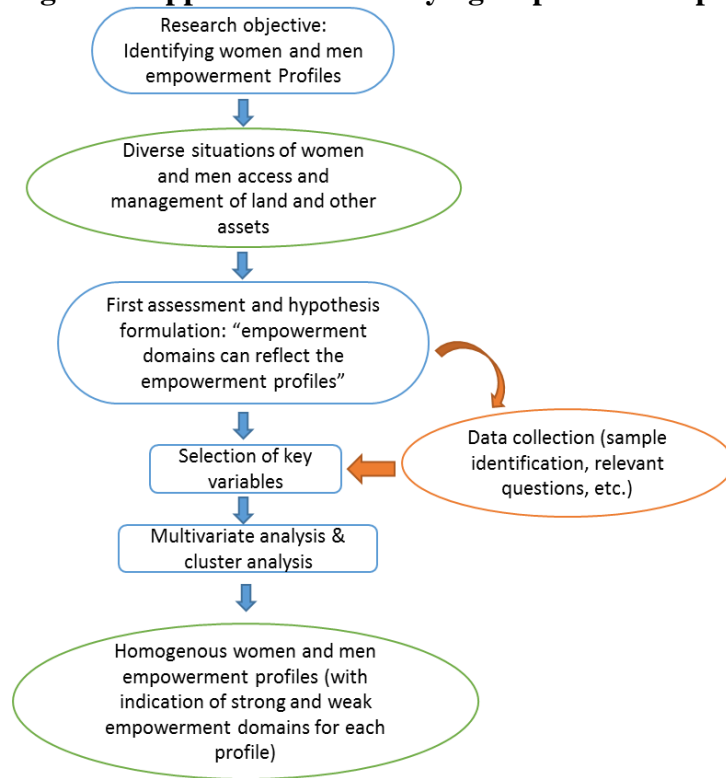
These variables strongly reflect the objective for which the typology is conducted in order to depict the different existing profiles of empowerment for men and women respondents. Empowerment domains are also integrated with the socioeconomic conditions of the respondent. The use of the socio-economic variables is necessary in order to account for the impacts of age and other social status on empowerment outcomes. The socio-economic variables as well as the number of livestock and area of land owned in the household are additional variables which does not exist in the original WEAI conception as defined by Alkire et al. (2013). The size of the land and size of cattle and small ruminants which the household owns were particularly added for better description of the second domain of WEAI. These factors are important to account when examining empowerment in Domain 2 related to the “access to and decision making power about production resources”. Clearly if a woman owns and/or controls one cow that is far less empowering than owning or controlling 30 cows. Thus, not only the ownership status matter, but also the scope and extend of such ownership.

The clustering approach is mostly driven by the data in the sense that relevant clusters can only be obtained if we use appropriate variables which properly reflects the objective of the analysis (Figure 2). As shown in Figure 2, women empowerment profiles are reflected through the main WEAI domains as identified by Alkire et al. (2013). Proxy variables of these domains were

² One kirat is equivalent to 1/24th of a feddan. These are the main units of area measurement in Egypt. One feddan is equivalent to 1.038 acres.

identified and used for multivariate cluster analysis in order to identify homogenous groups of men and women. By using both men and women in the clustering data, we can potentially verify whether some empowerment profiles could be exclusive for specific genders or not and derive recommendations to address gender gaps.

Figure 2. Approach for identifying empowerment profiles



Tables 4 and 5 presents a summary description of both continuous and dummy variables (described in Table 3) used in our clustering. Table 4 shows that average age in the sample is about 47 years old. Crop production is a primary activity in terms of revenue compared to the livestock activity. The average percentage of innovation adoption is higher for men compared to women. Average size of owned land is about 60 kirat (see table 4 for more details). However, there are regional differences in average land size, with one feddan (24 kirat) as average land size in Kafr Sheikh and five feddan as average land size in Noubariya.

Table 4. Descriptive statistics of the continuous clustering variables used in the clustering analysis

	Min	Max	Mean	SDEV
Age	20	77	46.66	10.98
Crop production value (in EGP)	0	60000	5691.58	6772.26
Livestock production value (EGP)	0	50000	2537.07	4442.63
Number of innovations relevant for men	0	5	3.49	1.51
Number of innovations relevant for women	0	5	2.50	1.64
Percentage of innovations adopted	0	300	36.38	29.34
Percentage of innovations adopted	0	67	7.26	12.61
Total land owned (in Faddan)	0	600	60.21	85.69
Number of buffalo and cows	0	11	1.19	1.48
Number of goats and sheep	0	20	0.64	1.85
Number of accomplishment	0	4	0.47	1.02
Total number of tasks in which women is involved	0	12	6.09	2.37
Percentage of tasks women do more than man	0	67	31.23	12.32
Total number of women working hours	0	1540	55.04	168.171

SDEV: Standard deviations; Min: minimum value; Max: maximum value

In terms of women access and management of assets, only 20% of women in our sample own land. Women in Kafr Sheikh were mostly renters of land or farming their male relatives' land. Women in the Noubariya, on the other hand, 50 out of the 100 surveyed owned land. It is also clear from Table 5 that women do have a decision to make in relation to crop production and management, while they appear to be lowly involved in the livestock production and management decisions, this is rather because the Noubariya region in general lacks livestock. It was also clear that even though some women are involved in decision making for crops and livestock production, their control over the income from these different activities is relatively low.

Table 5. Frequency distribution of dummy variables used in the clustering Analysis

Variable	Labels	Frequency	Percent
Gender	Women	202	50.2
	Men	200	49.8
Respondent head of household	Head	247	61.4
	Dependent	155	38.6
Decision making for crop production	No Decision-making power for women	110	27.4
	Women do have decision-making power	287	71.4
	Total	397	98.8
Women control of meat production	No Decision-making power for women	324	80.6
	Women do have decision-making power	78	19.4
Women Land ownership	No ownership for women	321	79.9
	Women own land	81	20.1
Women control of Land	No Decision-making power for women	297	73.9
	Women do have decision-making power	105	26.1
Women control of livestock assets	No Decision-making power for women	313	77.9
	Women do have decision-making power	89	22.1
Access to reliable source of credit	No	110	27.4
	Yes	292	72.6
Got any credit in the last three years	No	280	69.7
	Yes	122	30.3
Women Control crop Income	No Decision-making power for women	136	33.8
	Women do have decision-making power	266	66.2
Women control of Meat Income	No Decision-making power for women	329	81.8
	Women do have decision-making power	73	18.2
Women control of milk Income	No Decision-making power for women	272	67.7
	Women do have decision-making power	130	32.3
Membership to associations	No	263	65.4
	Yes	138	34.3

4. Results and Discussion

4.1 Identification of clusters based on PCA and K-Mean analysis

The output of the PCA is a components matrix, showing the different components (groups of variables) generated and the importance of each variable within its respective component (See Table 7). Results of this first PCA analysis provides 8 distinguished components (also called factors) based on an initial set of 27 variables, as shown in the summarized Table 7 below. These 8 factors are explaining 62.4% of the total variability in the initial dataset. The first, second and third factors explains respectively 16.7%, 14.7%, and 7.2% of the total variability of the sample (see table 6 for more details). A closer look at each factors in Table 7 helps identifying the main socioeconomic and women-empowerment-related variables strongly associated to each of our generated factors.

Table 6. Total Variance Explained by the generated PCs

Components (or factors)	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	4.508	16.697	16.697
2	3.966	14.691	31.387
3	1.962	7.265	38.652
4	1.741	6.448	45.100
5	1.290	4.778	49.878
6	1.242	4.599	54.477
7	1.115	4.130	58.607
8	1.031	3.818	62.426^(*)

(*) Total cumulative variance of the 8 generated components.

Table 7 also provides a brief narrative description of the obtained components which is elaborated based on the set of variables highly correlated under each of these components. The table shows that some components are composed on one or more WEAI -domain-variables, but none of the components is correlating variables from all WEAI domains. This component description will be used to explain the identified clusters in Table 8.

As described in the methodological section, the K-Mean clustering allows for testing different predefined numbers of clusters. In our case, the clustering iterations were stable for a predefined value of 5 clusters. The set of tests performed for the resulted clusters were highly significant. The resulted clusters are defined based their similarities (distance) to one or more of the generated components (see table 8). The 5 clusters obtained can be considered as credibly representing the types of farmers in our sample for the following two reasons:

1. Iteration history shows that convergence of changes in cluster centers was achieved (due to no or small changes in cluster centers) for the 5 generated clusters. The maximum absolute coordinate change for any center was 0.000 after the 6th iteration, which is a good indicators of the performance of the analysis. The minimum distance achieved between initial centers was about 13.9, which is also a reasonable value.
2. The ANOVA analysis performed for the differences of components means among the 5 identified clusters indicates a strong and significant differences among clusters for all of the 8 components. This is also a good indication that the generated profiles are significantly different from each other, and thus, highly eligible for representing the studied sample.

Table 7. Component matrix showing the type of background variables of each factor (an extended version of this matrix can be found in the supplementary files)

Generated factors (components)	SD	WEAI 1 Production	WEAI 2 Productive Resources	WEAI 3 Income	WEAI 4 Leadership	WEAI 5 Time	Brief description of the factors
1	++	+	++			+	Women
2		++	+	++		+	Men-led livestock system with good access to credit and a high number of tasks which women are involved in. Women in these households also have high control over milk and meat income.
3			+		++		Large land owners with participation on committees and accomplishments
4			+			+	Women-led land ownership with high number of working hours for women (this group also owns livestock)
5			+	+		++	High access to credit, women have high control over crop income, women have high working hours
6		++	+				Mixed crop-livestock system with high level of crop production income and livestock heads
7	+					+	Farmers more than 48 years of age with low adoption rates for agricultural innovations
8		++				+	High level of crop production income with women in these households doing more tasks than men

SD: Socioeconomic and demographic variables (+; ++; and +++ signs depends on the level of correlation of variables. +: correlation scores lower than 0.5; ++ correlation scores which are between 0.5 and 0.8; +++ correlation score higher than 0.8. Negative correlation score have not been considered)

Table 8 presents the list of 5 clusters identified using the K-Mean clustering, as well as the weight of each component in identifying the characteristics of each cluster. The highlighted numbers of Table 8 correspond to the closest component to which the respective clusters can be identified and described.

Table 8. Identification of clusters based on the generated components

Components / Regression factor scores.	Clusters				
	Crop Oriented Farming System	Women Landowners	Low Adoption Farmers	Men Large Landowners	Men-led Livestock producers
1	0.215	0.412	0.316	-0.946	-0.380
2	-0.205	-0.443	-0.361	-0.370	1.553
3	0.383	-0.201	-0.195	1.304	-0.476
4	0.198	0.600	-0.460	-0.214	0.662
5	-0.707	1.282	-0.323	-0.022	-0.243
6	1.715	0.237	0.058	-0.147	-0.539
7	-0.935	-0.014	0.242	-0.545	0.057
8	2.525	0.057	-0.280	0.012	0.124

Highlighted cells: Closest component to which the cluster can be identified/described

4.2 Narrative description of the identified clusters

Table 9 also shows that clusters 2 and 3 are dominated by women with 80.8% and 65.5% respectively of women presence in each of them. Clusters 4 and 5 are however dominated by men with 93.5% and 78% respectively of men cases in each cluster. Most of our sample cases belongs to cluster 3 representing around 30% of the whole sample, followed by cluster 5 which is

representing around 20% of the total cases in our sample. Tables 10, 11 and 12 provide further statistical description of the identified clusters. Based on these tables, a narrative description of the identified clusters can be as follows.

Table 9. Distribution by gender among the identified 5 clusters

		Total sample		Women		Men	
		Number of cases	Percentage	Number of cases	Percentage of Women in the cluster	Number of cases	Percentage of Men in the cluster
Clusters	(1) Crop Oriented Farming System	14	3.5	7	50	7	50
	(2) Women Landowners	68	17.1	55	80.8	13	19.1
	(3) Low Adoption Farmers	177	29.4	116	65.5	61	34.5
	(4) Men Large Landowners	61	15.3	4	6.5	57	93.5
	(5) Men-led Livestock production	77	19.3	17	22	60	78
Valid observations		397	100	199	50.1	198	49.9
Missing observations		5	-				

Highlighted cells: clusters dominated by women.

Table 10. Distribution of the identified clusters by gender and area

		Cluster Number				
		1	2	3	4	5
Women	Noubariya	3	44	42	4	6
	Sidi Salem	4	11	74	0	11
Men	Noubariya	7	10	43	35	5
	Sidi Salem	0	3	18	22	55

The first cluster relates to households mostly involved in crop-oriented farming systems with high income from crop production involving high number of tasks for women at the farm. This first clusters in equally composed of men and women (with only 7 women found as belonging to this group). This group actually has the highest crops income and number of tasks for women among all other groups (Tables 11 and 12). These findings suggest that women in both regions are highly involved in crop production and not only in livestock activities as is it has been widely believed (e.g. seen Badran 1993).

The second cluster is dominated by women who own land and have control over crop income. This cluster represents only 17% of the total sample (including 55 women mostly from Noubariya). These women also have good access to credit and control over income (at 87% the highest among of the groups). Women in the households of this cluster also have highest percentage of tasks done by women among all other groups. This group also owns livestock, with the highest number of goats and sheep. Total land owned is the highest for this cluster among other groups.

The third cluster is also dominated by women who have an average age of 48 years (mostly from Sidi Salem area). This cluster is characterized by low level of adoption of innovations. This can be attributed to their limited access to credit and labour (Doss 2001). A good number of women in households of these clusters have high decision making power in crop production (56% of this group have decision making power in crop production despite the fact that only 25% of them own land). However, in this group only 45% of women have decision-making power over crop income control. This percentage is only 2 and 15% in the case of meat and milk, respectively. Women in this group have decision-making power over land control in 31% of cases, although mostly men

are land owners. In this cluster this group has reliable source of credit in 71% of cases but only 15% of this group actually took credit. Membership in public life is low for this cluster as only about 20% of the cases are members in farmers associations.

The fourth cluster is mostly composed of men who are large landowners and having the highest participation on committees (82% are members of committees) and also the highest accomplishments on these committees. Women in this cluster are only a minority (4 representing 6.5% of the total number of cases in this cluster, and are all from the Noubariya area). This group also have the highest percentage of innovations adopted, which could be expected due to their high involvement and participation in associations.

The fifth cluster is mostly dominated by men (78% of the respondents in this cluster are men, mostly from Sidi Salem area) who have the highest number of livestock owned. This group includes only 17 women which are mostly located in Sidi Salem area. This group also have good access to credit. Women in these households also have high control level over milk and meat income. In fact, around 87%, 90%, 90% of women in this group have control over crop, meat and milk incomes, respectively. Land in this cluster is owned by men, while women contribute with high working hours for the major crops in the area and are also involved in a high number of tasks in which women are involved. This cluster has the highest livestock production value the highest number or innovations relevant for men. This group has the least land owned by area but the highest number of buffalo and cows. Despite the fact that 90% of these household have women with decision making power in crop production, only 14% of these households have land which is owned and/or controlled by women. However, in terms of livestock control as an asset, women in this cluster have low power (in only 14% of households women control livestock asset).

Table 11. Descriptive statistics of each of the identified clusters

	Crop Oriented Farming System		Women Landowners		Low Adoption Farmers		Men Large Landowners		Men-led Livestock production		Total	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Age	42.6	11.5	39.8	8.1	48.0	10.7	47.5	11.8	50.3	10.3	46.8	11.0
Crop production value	30035.7	15008.3	6047.3	4461.4	4227.7	4385.4	6234.2	3815.6	3923.6	3312.2	5698.8	6797.5
Livestock production value	2050.0	2551.8	1614.0	2575.7	1734.8	2655.5	582.0	1483.1	6998.7	7290.1	2569.0	4461.4
Number of innovations developed by men	4.1	1.5	3.0	1.3	3.5	1.7	2.9	1.3	4.3	0.9	3.5	1.5
Number of innovations developed by women	2.7	1.8	2.3	1.3	2.6	1.7	1.2	1.2	3.4	1.5	2.5	1.7
Percentage of innovations adopted	30.7	14.6	40.1	28.8	26.5	17.2	63.7	50.4	35.7	14.7	36.5	29.4
Percentage of innovations adopted	3.2	8.5	6.3	13.9	9.8	13.5	4.8	11.6	5.1	9.8	7.3	12.7
Total land owned	34.9	32.3	86.9	92.1	59.0	93.7	61.4	56.8	46.2	84.1	60.8	86.0
Number of buffalo and cows	1.4	1.7	1.3	1.3	0.9	1.3	0.8	1.2	2.1	1.9	1.2	1.5
Number of goats and sheep	0.3	1.1	1.2	3.5	0.5	1.2	0.3	0.8	1.0	1.7	0.6	1.9
Number of accomplishment	1.1	1.6	0.2	0.8	0.0	0.1	1.8	1.3	0.6	1.0	0.5	1.0
Total number of tasks in which women is involved	7.8	3.2	6.6	2.2	6.1	2.4	4.3	1.8	6.8	1.9	6.1	2.4
pct of tasks women do more than man	31.3	11.5	34.6	13.0	31.9	11.8	25.3	15.4	31.6	8.8	31.3	12.3
Total number of women working hours	17.5	36.9	229.1	352.9	25.1	42.0	4.3	12.8	16.6	39.1	54.9	169.0

Table 12. Frequency distribution of dummy variables for each of the identified clusters

		Cluster Number of Case										Total Count
		Crop Oriented Farming System		Women Landowners		Low Adoption Farmers		Men Large Landowners		Men-led Livestock production		
		Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.	Count	Pct.	
Total number of cases in the cluster		14		68		177		61		77		
Gender	Women	7	50	55	81	116	66	4	7	17	22	199
	Men	7	50	13	19	61	34	57	93	60	78	198
HH	Respondent head of household	9	64	20	29	93	53	55	90	68	88	245
	Respondent is dependent	5	36	48	71	84	47	6	10	9	12	152
Decision making in crop production	No Decision-making power for women	6	43	11	16	78	44	7	11	8	10	110
	Women do have decision-making power	8	57	57	84	99	56	54	89	69	90	287
Women control for meat production	No Decision-making power for women	14	100	68	100	173	98	60	98	4	5	319
	Women do have decision-making power	0	0	0	0	4	2	1	2	73	95	78
Land ownership	No ownership for women	10	71	39	57	142	80	59	97	66	86	316
	Women own land	4	29	29	43	35	20	2	3	11	14	81
Land control	No Decision-making power for women	8	57	38	56	123	69	57	93	66	86	292
	Women do have decision-making power	6	43	30	44	54	31	4	7	11	14	105
Livestock control	No Decision-making power for women	11	79	42	62	128	72	61	100	66	86	308
	Women do have decision-making power	3	21	26	38	49	28	0	0	11	14	89
Reliable Credit	No	2	14	24	35	52	29	20	33	10	13	108
	Yes	12	86	44	65	125	71	41	67	67	87	289
Got Credit	No	11	79	34	50	151	85	37	61	44	57	277
	Yes	3	21	34	50	26	15	24	39	33	43	120
Control crop Income	No Decision-making power for women	6	43	9	13	97	55	11	18	10	13	133
	Women do have decision-making power	8	57	59	87	80	45	50	82	67	87	264
Control Meat Income	No Decision-making power for women	14	100	68	100	173	98	61	100	8	10	324
	Women do have decision-making power	0	0	0	0	4	2	0	0	69	90	73
Control Milk Income	No Decision-making power for women	9	64	42	62	151	85	57	93	8	10	267
	Women do have decision-making power	5	36	26	38	26	15	4	7	69	90	130
Membership	No	7	50	60	88	141	80	10	16	40	52	258
	Yes	7	50	8	12	36	20	50	82	37	48	138

We finally mapped the different empowerment profiles of the identified clusters in order to generate gaps of each cluster in terms of WEAI empowerment domains (see Table 13 elaborated as a combination of tables 7 & 8). It is again clear that Cluster 5 is the most empowered group of women but still have some gaps in terms of participation in collective action and farmers' association. A part from a minority of farmers in cluster 4, almost all clusters in the studied sample needs to be further empowered regarding this particular domain.

Table 13. Maps of the empowerment profiles for each cluster

	WEAI 1 Production	WEAI 2 Productive Resources	WEAI 3 Income	WEAI 4 Leadership	WEAI 5 Time
Cluster 1	++	+			+
Cluster 2		+	+		++
Cluster 3	+	++			+
Cluster 4		+		++	
Cluster 5	++	+	++		+

Women in households of cluster 1 are the least empowered and need to be further empowered in terms of “production”, “Income”, “leadership” and “time” domains. Even though women in all groups do have some scope for accessing and using production resources, their control over income is still very low and needs to be empowered, specifically in clusters 1,3 and 4. Cluster 2, however, which is mostly comprised of women who own land, reveals that women in this group are controlling income. Similarly, leadership domain is also very low and for all women in the 5 clusters. Cluster 4 is reflecting men’s, and not women’s, strong participation in the leadership domain. As mentioned earlier, leadership domain is reflective of the respondent rather and not necessarily women in the household as with the other domains. In the time domain, women who own land (Cluster 2) have the highest work burden and women in households where men own large land (Cluster 4) have the least work burden, perhaps due to the heavier mechanization of these farms. Women in households of cluster 1,3, and 5 also have a heavy work burden.

5. Conclusion

This paper focused on developing farmers’ typologies by developing correlation patterns in a group of variables related to the Women’s Empowerment in Agriculture Index based on 402 selected farmers in the Old and New Lands of Egypt. In a review of the literature on the contribution of agriculture to growth and poverty reduction in Africa, Dercon and Gollin (2014, 12) argue that heterogeneity “is a fundamental characteristic of the sector at all levels” and that heterogeneity should guide major public investments in the agriculture sector. In particular, that multiple agricultural strategies need to be designed in order to account for regional and socio-economic variations of farmers (Dercon and Gollin 2014). The approach that we have used offers typologies of women on an empowerment continuum in which interventions at different levels of leadership, time poverty and control over resources are needed for the design of effective policy interventions and investments aimed at empowering women.

Our findings reveal that land ownership is important especially in increasing women’s ability to control agricultural-related income and as such it is important to strengthen women’s access to land. However, leadership participation and time constraints require more attention for all the empowerment profiles identified. This could be achieved, for example, through women participation quotas in local governance committees and increasing women’s access to labour saving technologies.

Our findings also reveal that women's empowerment can be related to the type of the farming systems in which women are operating. The most empowered are those who belong to the cluster dominated by the livestock production systems. We also found that women who own land are not necessarily the most empowered. This suggests that we need to pay attention to multiple domains and assets for women's empowerment and not only to land ownership and control. Furthermore, it seems it is easier for women to be economically empowered in terms of controlling income and owning productive resources. However, women were far less likely to be empowered in participating in public life, which needs a careful attention from policy makers and development agencies. A man's cluster had the highest empowerment profile in participating in public life.

References

- Abdelali-Martini, M., and Aw-Hassan, A. 2013. *Gender Research in Natural Resource Management: Building Capacities in the Middle East and North Africa*. Routledge.
- Agarwal, B. (1994). *A Field of One's Own: Gender and Land Rights in South Asia*. Cambridge: Cambridge University Press.
- Agarwal, B. (2003). Gender and land rights revisited: exploring new prospects via the state, family and market. *Journal of Agrarian Change*, 3(1-2):184-224.
- Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., & Vaz, A. (2013). The women's empowerment in agriculture index. *World Development*, 52, 71-91.
- Baruah, B. 2010. *Women and Property in Urban India*. Vancouver: University of British Columbia Press.
- Bernard, H. R. (2006). *Research Methods in Anthropology: Qualitative and Quantitative Approaches*. Oxford: Altamira Press.
- Carr, Marilyn, Martha Alter Chen, and Renana Jhabvala, eds. *Speaking out: Women's economic empowerment in South Asia*. Intermediate Technology, 1996.
- Corcoles JI, de Juan JA, Ortega JF, Tarjuelo JM, Moreno MA. 2010. 'Management evaluation of Water Users Associations using benchmarking techniques'. *Agricultural Water Management*, 98, p. 1-11.
- Datta, N. (2006). Joint titling – a win-win policy? *Feminist Economics* 12(1-2):271-298.
- De la O Campos, A. P., Covarrubias, K. A., & Prieto Patron, A. (2016). How Does the Choice of the Gender Indicator Affect the Analysis of Gender Differences in Agricultural Productivity? Evidence from Uganda. *World Development*, 77, 17–33. doi:10.1016/j.worlddev.2015.08.008
- Dercon, Stefan, and Douglas Gollin. *Agriculture in African development: A review of theories and strategies*. No. WPS/2014-22. 2014.
- Doss, C. R., & Morris, M. L. (2001). How does gender affect the adoption of agricultural innovations?: The case of improved maize technology in Ghana. *Agricultural Economics*, 25(1), 27-39.
- FAO. 2011. *The State of Food and Agriculture. Women in Agriculture. Closing the gender gap for development*. FAO, Rome.
- Frija, A., Chebil, A., & Speelman, S. (2016). Farmers' Adaptation to Groundwater Shortage in the Dry Areas: Improving Appropriation or Enhancing Accommodation?. *Irrigation and Drainage*, 65(5), 691-700.
- Goyeneche R, Roura S, Di Scala K. 2014. Principal component and hierarchical cluster analysis to select hurdle technologies for minimal processed radishes. *LWT - Food Science Technology*. 57, 522–529. doi:10.1016/j.lwt.2014.02.022
- Graeb, B. E., Chappell, M. J., Wittman, H., Ledermann, S., Kerr, R. B., & Gemmill-Herren, B. (2015). *The State of Family Farms in the World*. *World Development*. doi:10.1016/j.worlddev.2015.05.012

- Jackson, C. (2003). Gender analysis of land: beyond land rights for women? *Journal of Agrarian Change*, 3(4):453-480.
- Keenan T, Baker I, Barr A, Ciais P, Davis K, Dietze M, Dragoni D, Gough CM, Grant R, Hollinger D, Hufkens K, Poulter B, McCaughey H, Raczka B, Ryu Y, Schaefer Y, Tian H, Verbeeck H, Zhao M, Richardson AD . 2012. 'Terrestrial biosphere model performance for inter-annual variability of land-atmosphere CO2 exchange'. *Global Change Biology* 18, 1971–1987.
- Kilic, T., Palacios-López, A., & Goldstein, M. (2015). Caught in a Productivity Trap: A Distributional Perspective on Gender Differences in Malawian Agriculture. *World Development*, 70, 416–463. doi:10.1016/j.worlddev.2014.06.017
- Medina, G., Almeida, C., Novaes, E., Godar, J., & Pokorny, B. (2015). Development Conditions for Family Farming: Lessons From Brazil. *World Development*, 74, 386–396. doi:10.1016/j.worlddev.2015.05.023
- Molden, D., OWEAI s, T., Steduto, P., Bindraban, P., Hanjra, M.A., Kijne, J., 2010. Improving agricultural water productivity: between optimism and caution. *Agricultural Water Management, Comprehensive assessment of Water Management in Agriculture* 97 (4), 528–535.
- Moors, A. (1996). Gender relations and inheritance: person, power and property in Palestine. In Kandiyoti, D., ed. *Gendering the Middle East*, pp. 69-84. Syracuse: Syracuse University Press.
- Mwesigye, F., & Matsumoto, T. (2016). The Effect of Population Pressure and Internal Migration on Land Conflicts: Implications for Agricultural Productivity in Uganda. *World Development*, 79, 25–39. doi:10.1016/j.worlddev.2015.10.042.
- Najjar, D. (2013). *The Money of Qaroon and the Patience of Ayoub: Women and Land in Egypt's Mubarak Resettlement Scheme*. PhD Dissertation, Department of Anthropology, University of Western Ontario.
- Najjar, D. (2015). Women's Contributions to Climate Change Adaptation in Egypt's Mubarak Resettlement Scheme through Cactus Cultivation and Adjusted Irrigation. In Buechler, S. and Hanson, AM. (Eds). *A Political Ecology of Women, Water and Global Environmental Change*. Chapter 8. London and New York: Routledge.
- Njuki, J., Baltenweck, I., Mutua, E., Korir, L., & Muindi, P. (2014). Women's empowerment in collective dairy value chains (Vol. 38). ILRI (aka ILCA and ILRAD).
- Patton, M. Q. (2002). *Qualitative research*. Thousand Oaks, CA: Sage Publications.
- Razavi, S. (2007). Liberalisation and the debates on women's access to land. *Third World Quarterly*, 28(8):1479-1500.
- Razavi, S. (2009). Engendering the political economy of agrarian change. *Journal of Peasant Studies*, 36(1):197-226.
- Sarbu C, Nascu-Briciu RD, Kot-Wasik A, Gorinstein S, Wasik A, Namiesnik J. 2012. 'Classification and fingerprinting of kiwi and pomelo fruits by multivariate analysis of chromatographic and spectroscopic data'. *Food Chemistry*, v.130, p.994-1002.
- Schuler, Sidney Ruth, and Syed M. Hashemi. "Credit programs, women's empowerment, and contraceptive use in rural Bangladesh." *Studies in family planning* (1994): 65-76.

- Sraboni, E., Malapit, H. J., Quisumbing, A. R., & Ahmed, A. U. (2014). Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh? *World Development*, 61, 11–52. doi:10.1016/j.worlddev.2014.03.025
- Stauth, G. (1990). Women, Properties, and Migration: Access to Land and Local Conflicts in Rural Egypt 3 *Zeitschrift Der Deutschen Morgenlandischen Gesellschaft*, pp. 32-50.
- United Nations Economic Commission for Africa. (2007). Women and Access to Land and Credit: Discussions and Key Findings of the African Gender Development Index in Selected African Countries. Retrieved on July 19, 2010 from <http://webcache.googleusercontent.com/search?q=cache:9CavZ4Cij4cJ:awro.uneca.org/downloads/Women%2520and%2520Access%2520to%2520Land%2520and%2520Credit.%2520LD%2520Edited%252006%252009.doc+Women+and+Access+to+Land+and+Credit:+Discussions+and+Key+Findings+of+the+African+Gender+Development+Index+in+Selected+African+Countries&cd=2&hl=en&ct=clnk&gl=ca>.
- Varley, A. (2007). Gender and property formalization: conventional and alternative approaches. *World Development*, 35(10):1739-1753.
- wa Gĩthĩnji, M., Konstantinidis, C., & Barenberg, A. (2014). Small and productive: Kenyan women and crop choice. *Feminist Economics*, 20(1), 101-129.
- Walker, Cheryl. "Piety in the sky? Gender policy and land reform in South Africa." *Journal of Agrarian change* 3, no. 1-2 (2003): 113-148.
- Whitehead, A., and Tsikata, D. (2003). Policy discourses on women's land rights in Sub-Saharan Africa: The implications of the re-turn to the Customary. *Journal of Agrarian Change*, 3(1-2), 67-112.