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The Capacity of a Household Farming System with Women's Decision and Action-Making Power: Rural Marginal Areas in Morocco

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Abstract: Nowadays, women's contribution to society through their social and human involvement at the household level in terms of education, care, and nutrition, as well as their added value to economic functioning, is increasingly recognized. However, most of the related research highlights the relative contributions of women and men. This paper proposes to analyze the link between women's contribution to social, economic, and financial activities and the rural livelihood of the whole household farm. Based on a household survey that included a respondent section for women from over 285 families in the least rurally developed regions of Morocco, descriptive statistics and systemic analysis successively based on multiple factorial and clustering analyses were used to analyze the links between household adaptative capacity and women's material and immaterial contributions. The results revealed that women play a crucial role in intergenerational knowledge transfer, which constitutes a critical factor in household capacities and reproduction, especially in the least endowed households. However, the women's farm or off-farm activities did not guarantee their autonomy. So, the contribution of women to household farm livelihood through their know-how opens alternative pathways to reconsider their contribution to the overall goal of livelihood improvement.

Keywords: women empowerment; adaptive capacity; livelihoods; rural household; Morocco

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1. Introduction

Nowadays, women's contributions to society through their social and human involvement at the household level regarding education, care, and nutrition and their added value to economic functioning are increasingly recognized in the academic and development literature [1–3]. However, despite this statement, research and development studies demonstrate that unequal access to physical resources always makes women's roles and contributions invisible [4,5]. Moreover, most women in rural areas of developing countries provide unpaid labor on household farms. So, they are assumed to be (and may even see

themselves as) economically inactive or, at most, helpers to male farmers. The lack of assets and recognition of the importance of domestic or on-farm work would partly explain the low representation of women in the various institutions and committees where decisions are made [6–9]. In this context, recognizing and valuing women's contributions and full involvement in society and the economy remains challenging, particularly in developing countries' rural economies. Over the last decade, there has been an increasing number of initiatives from research and development projects that favored women's access to economic activities in rural zones. The focus was on involving women in the decision-making processes, from the design to the implementation of socio-technical innovations [10]. Other research and development actions aimed at stimulating women's accumulation of assets through training, acquiring sufficient knowledge, or promoting associations to enhance their access to public aid and empowerment. Despite some progress in the field of positive law in terms of gender equality, women, especially in rural areas, remain in a concrete state of inferiority compared to men, either in terms of land and inheritance or access to qualified jobs [11].

In parallel, a broad range of literature has emerged on the adaptive capacity of farmers to cope with various changes in their environment and the impact on their livelihoods, mobilizing different theoretical frames and approaches around resilience and vulnerability concepts [12,13] or the sustainable livelihood frame [14,15]. Most of these research works referred to the capabilities, assets (including material, human, and social resources), and activities embedded in the adaptive capacity to maintain or enhance living conditions. Here, the adaptive capacity of rural householders reflects their ability to cover the needs of the households. The sustainable livelihood frame developed by Chambers and Conway (1992) allowed us to address the different dimensions of adaptive capacity strategies by including resource endowment and resource use and the means and rights of access to these resources [16,17]. Along this line, the adaptive capacity of the household is approached through three components: endowment or tangible assets (land, livestock, and housing), human capacity and capability (family composition, off-farm activities, and education and health), and economic indicators based on expenses and incomes (proxy of economic well-being or livelihoods) at the household farm level. Although some mentioned the role or aspirations of women in whole-farm strategies, their specific roles and involvements in the adaptive capacity of the household farms remain incipient. In the present paper, it is discussed that through their multiple contributions at the domestic and farm levels, women are supposed to play a substantial role in the whole household farm's adaptive capacity and livelihood. Due to this, defining and quantitatively approaching the multiple contributions of women in a household farm's livelihood was proposed.

Several challenges ensued from the attempts to value women's contributions to livelihoods. Firstly, working at the household level implies making assumptions about economic and financial costs and benefits distributions. The collection of sex-disaggregated data allowed observing and analyzing the specific contributions of women compared to men at the household level [18]. However, considering the household as a social system, the sum of women's and men's contributions will not allow an understanding of their contributions and gaps according to the systemic approach in which the relations create something different from the sum of the actor's contribution. The second challenge is related to the sustainable livelihood approach by itself. Suppose assets accumulate over time, which provides a more holistic approach to capacity than incomes and expenditures. The assets' endowment approach raises the problematic rights issues faced by the complexity of ownership in many countries. As shown in [18], land ownership takes various forms: with/without formally documented ownership, how can we address jointly owned land?

The sustainable livelihood approach also includes the human and social assets that refer directly to personal empowerment (such as people's confidence and skills) and social empowerment related to the existence of representative organizations in the capacity to make decisions on priority development activities [19]. Measuring women's non-monetary contribution to household human and social assets, notably in terms of non-tangible goods and services and concessions to property rights women will fully make to maintain kinship relations in their households, requires considering the type of decision-making women are involved in. While data from household surveys often assume that joint decision-making is egalitarian, emerging evidence reveals differences between men's and women's perceptions of joint decision-making. For instance, in Morocco, Najjar et al. (2021) showed that, while women explained collective decision-making by gaining approval from their husbands, men explained decision-making as informing their wives of their decisions [20]. However, while decision-making within the farm activities often eludes women, it is less evident in the domestic sphere, where the woman establishes her hold. Also, for working women out of the farm, a distinction must be made between the female household helpers who contribute to production without being recognized and the female salaried workers who are forced to travel far from home. While the former continues to be under the control of the male authority (e.g., husband, father, or brother), the latter moves away from it and then acquires a sort of provisory autonomy. However, in this situation, they generally suffer gender discrimination through salary, sexual harassment, and seasonal work opportunities [21]. All these elements highlight the need to consider several pieces of information to capture the role and place of women in this system. Following this line, many researchers focused on the econometric approaches demonstrating differential decision-making per gender [20,21]. This heuristic approach is essentially carried out in specific spaces where the representations of the status and role of women that developed are known and often represented through the rules that govern access to the means of production, the off-farm salaried work opportunities, and actions taken in terms of human development and the reinforcement of cooperative structures and women's associations. This approach makes it possible to identify variations at the household level according to men's authority and women's capacity to exercise their agency. Generally, these approaches highlighted the inequity between women and men with regard to access to goods and services, education/training, etc. [3,18].

The present paper proposed not to compare women's and men's household contributions but to examine women's specific contributions to agriculture, income generation, subsistence, asset ownership, and involvement in decision-making at the household farm level. This analysis aims to observe women's contribution to the livelihood of the whole household farm. The research question explores how women's capacity can impact the adaptive capacity and livelihoods of the household farm system. To do so, indicators were established to assess women's influence and contribution to the household farms' adaptive capacity and livelihood. The influence of women and their contributions are addressed through six components: (1) Women's involvement in terms of time participation in different types of activities (i.e., domestic, on-farm, and off-farm activities); (2) Women's involvement in immaterial activities (like local knowledge, culture transmission, biodiversity maintenance, etc.); (3) Women's asset ownership (including jewelry, TV, phone, land, livestock, etc.); (4) Women's empowerment determinants (education, participation in cooperatives or associations, training, community credit); (5) Women's decision-making power (distinguishing giving advice or deciding in regard to the three main subsystems, i.e., crop, livestock, and household); (6) Women's autonomy regarding having control over income expenditure. This research has been conducted in southeast Morocco's least developed rural zones where women occupy a fundamental role in domestic and farm

activities. This role has had a known consequential increase over the last decades due to the rural exodus of men.

So, after presenting the studied area, the material, and the method in the following section, the results are structured into two sub-sections. The first subsection describes and analyzes the diversity of household farm systems in the studied zone and the differential contributions of women along a gradient from the remote zones of mountains and oases to the agricultural plains. Then, in the second subsection, the links between the various contributions of women and the overall household farm livelihood are explored using factorial analyses to identify women's participation in the adaptive capacity of the household.

2. Materials and Method

2.1. Study Area

The present study was commissioned by the Centre d'Etudes et Recherches du Crédit Agricole du Maroc (CERCAM) to quantitatively analyze the socioeconomic roles of women living on small and medium-sized household farms in southwestern Morocco. CERCAM targeted low-developed territories in the Southern Morocco region along a geographical transect from the Hight Atlas to the coastal zone (zones 1 to 3) and from a gradient of aridity from the coast to the oasis (zones 3 to 5). In the five zones, the dominant land structure is micro-properties and landlessness. The five zones also presented geographical diversity in terms of distance from the city and according to the access to hydro-agricultural perimeters. Figure 1 represents the five zones according to the rural and urban population, the average land size in ha, and an indicator of local development based on the general census of population and habitat [22] and the National Observatory of Human Development [23].

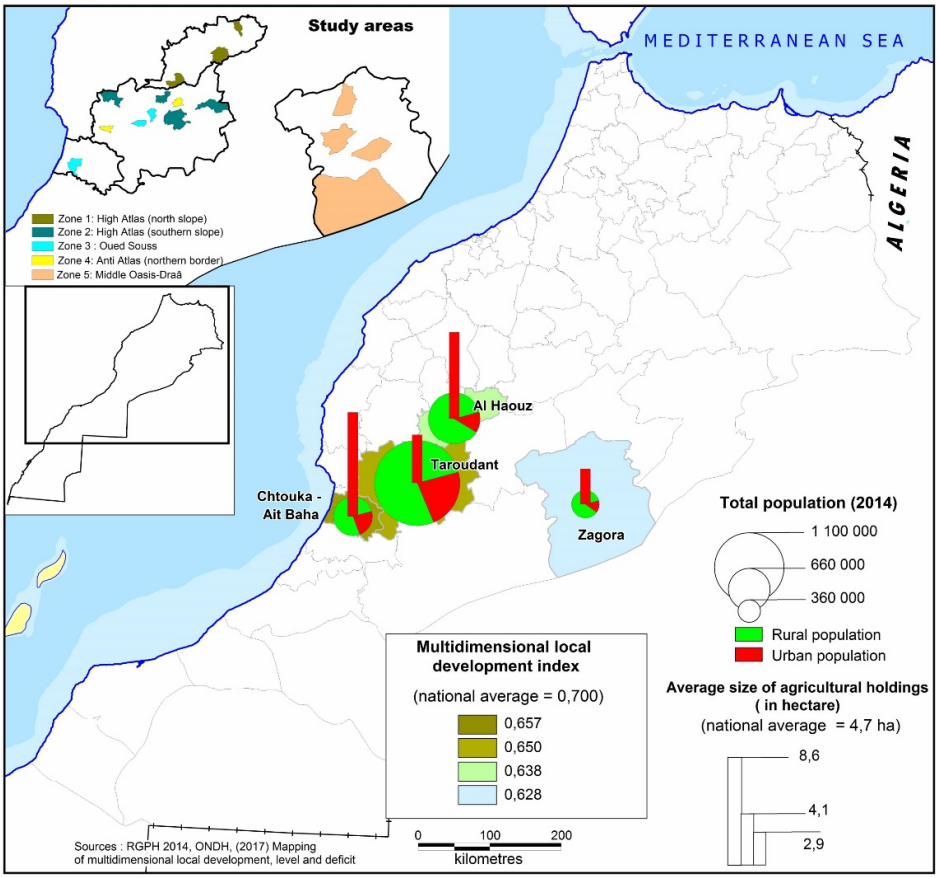

Figure 1. Presentation of the five selected zones of the study in Morocco (in the top left corner) chosen from the multi-dimensional local development mapping extracted from RGPH (2014) and ONDH (2017) [23,24].

The first zone on the 'Northern side of the High Atlas' (z1) is characterized by the preponderance of an agropastoral system due to the mountainous relief. However, the proximity of a large city (Marrakech) offers various opportunities for valorizing on-farm products or employment access in other sectors of the economy. The second zone in the 'Southern side of the High Atlas' (z2) corresponds to part of the Oued Souss watershed related to the province of Taroudant, where aridity and the mountainous relief limit agricultural land development. Goat farming combined with argan forest exploitation constitutes the agro-sylvo-pastoral system's main components. On the other hand, the southern regions have developed modern irrigated agriculture due to the water infrastructure. So, the geographic position of the municipalities in this zone explains the main characteristics of rural households there in terms of farm activities and revenues. The third zone in the 'Oued Souss' (z3) belongs to the plain of Souss Massa on the coastal side. The relatively arid climate (around 240 mm of rain on average per year) is nuanced towards the coast by the humid influence of the ocean and inland by the dry winds from the South and the East. Due to suitable irrigation systems, family farms can practice a polyculture of food crops associated with extensive goat rearing. Agriculture, tourism, and sea fishing are the pillars of these systems. In the South, the fourth zone, the 'North side of the Anti Atlas' (z4), has had the important development of modern irrigated agriculture that has generated agricultural and non-agricultural off-farm jobs for the smallholder farms. Continuing into the East, the last and fifth zone was the 'Oasis of the middle Draa' (z5), composed of six palm groves: Mezguita, Tinzouline, Ternata, Fezouata, Ketaoua, and Mhamid el Ghozlan. The economy is mainly based on palm trees, small ruminants, and touristic activities.

Thus, these five zones cover a geographical transect from the mountain areas to the oases or peripheral regions of the extensive agricultural plains in south Morocco. The dominant family farm system in these five zones is small-scale household farming, which combines crop and livestock activities for subsistence and market.

2.2. Material

The dataset used in the present paper has been extracted from a household survey conducted in 2016 with 300 household farms distributed equally in the five zones. The targeted population was household farms characterized by a close relationship between the domestic sphere and agricultural production, as defined by Marzin et al. (2017) [25]. In 2020, additional interviews were conducted with four leaders (two women and two men) in the five studied zones to understand the zones' essential characteristics, such as gender roles, primary agricultural commodities, and migration patterns. All participants involved in the household survey and interviews gave their oral consent.

The household survey developed in 2016 was composed of two questionnaires. The first was an agricultural household questionnaire to collect general data on all household members and their farm and non-farm activities. The respondents were the heads of the household, mainly men, representing 87.3% of household heads and 12.7% of women. This questionnaire included eight modules dealing with the following themes: socio-demographic characteristics of household members, sources of income, living and housing conditions (equipment and access to facilities like water or electricity), food consumption (self-consumption and purchases), agricultural systems (areas owned and cultivated, irrigated or not, production systems, etc.), crop and animal productions of the 2015–2016 agricultural season, distribution and organization of rural work between the various members of the household of working age and present on the farm.

The second questionnaire concerned the leading woman in the household, generally the wife of the head of the household or another female member of the family farm headed by a woman. The questionnaire was composed of thirteen modules: individual

characteristics, quality of life and health of women, distance from essential services, care for dependent people, income from activities and other financial resources (land, etc.), in-kind donations, and intra- or inter-household cash transfers, behavior and decision-making methods in the farm, financing methods, access to agricultural production factors, self-assessment of the intangible goods and services (e.g., child education, care of elders, health care) and, finally, an agenda of daily activities. In the agenda of daily activities, the enumerator records all the activities per half-hour of the women respondents over the last 24 h. A rapid description of the survey and dataset is given by Romagny et al. (2018) [26].

A random sampling approach was applied to select four villages per zone, and fifteen householders per village were selected using snowball sampling [27]. The two questionnaires were tested and adjusted in one village. Ten Berber-speaking graduate students from the university were trained, and the survey was conducted and supervised by five regional supervisors from local organizations. The two questionnaires were applied to the same 300 household farms. Data entry was entered and organized using Data ACCESS software (Microsoft Office 2015). Data from one village in the fourth zone (North Anti-Atlas) was not considered in the present work due to missing data. So, in the present paper, the final sample was 285 households, with 60 households in each zone, except for zone 4, which comprises 45 households.

Table 1 briefly summarizes each zone's different household farming systems. The specific crop system based on palm trees in the oases (z5) is easily identifiable. Then, there is a gradient from the South, with the most diversified crop-livestock system in zone 3, to the North, with zones 1 and 2 in the mountainous areas where the agropastoral system is predominant. Zones 1 and 2 differ by the relief and climate, which explains the most diversified tree plantation in zone 2. Zone 4 is the most isolated and abandoned between the plain and the mountainous zone.

Table 1. Descriptive statistics of the household farming systems by zone (average per zone) (300 households, 2016).

Items	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa
Household size (members)	6.7	5.8	5.8	4.0	9.9
Land ownership (ha)	2.2	1.4	1.1	2.0	1.7
Bovine (heads)	1.5	1.9	1.4	0.4	0.6
Small ruminants (heads)	17.9	24.5	4.4	8.6	5.2
Poultry (heads)	5.1	4.5	3.6	3.2	0.7
Palm tree (nb.)	0.0	0.0	2.1	0.0	95.6
Olive tree (nb.)	28.2	19.7	2.5	0.1	0.0
Other trees (nb.)	7.2	20.1	7.5	6.7	2.5
Wheat area (ha)	1.6	0.6	1.0	0.0	0.7
Barley area (ha)	0.2	0.5	0.3	0.3	0.0
Maize area (ha)	0.0	0.0	0.1	0.0	0.0
Leguminous area (ha)	0.0	0.0	0.5	0.0	0.0
Forage area (ha)	0.0	0.0	0.0	0.0	0.1
Other crops area (ha)	0.0	0.1	0.0	0.0	0.0

2.3. Methods

Our methodology was multi-staged. The first step aimed to understand the different levels of women's capacity per zone in terms of involvement in income generation (through financial contribution), time involvement (differentiating the time for domestic and farm activities), empowerment (concerning the women's association, and the place and role of women in the decision process and decision-making), monetary contributions and endowment (land, livestock or various goods). A set of variables was selected and split into six themes (see Table 2, level 'Woman').

Table 2. Groups of variables by theme for the multiple factorial analysis (MFA).

Level	Themes	Label of the Theme	Number of Variables	Active Theme *
Household farm	Physical assets (land, livestock, equipment)	HH_Asset	17	0
	Human asset (family composition, off-farm activity, education)	HH_Human	11	0
	Household expenses and incomes	HH_Income	8	0
Woman	Involvement of women in external tasks	W_Task	23	1
	Involvement of women in domestic tasks	W_Immaterial	9	1
	Physical asset	W_Asset	10	1
	Human asset	W_Asset_Human	12	1
	Empowerment	W_Opinion	8	1
	The economic contribution of women	W_Income	8	1
Region		Region *	1	0

* Active themes gather the variables that define the factorial axis of the analysis, although the other variables (when active theme = 0) are only projected on the factorial plan.

Two themes reflected the time involved in socioeconomic and sociocultural activities, respectively. The socioeconomic activities covered all the income-generating activities such as crop, livestock, and off-farm activities ('Involvement of women in external tasks'). So, the external tasks included activities outside the domestic sphere, even if the terminology can be ambiguous around the strong interrelations between farm and household activities. Sociocultural activities encompassed all domestic tasks, including women's contributions to transferring knowledge, cultural habits, or know-how knowledge passed onto children (included under 'Involvement in domestic tasks'); the other themes comprised women's physical and human assets. The physical assets included land, livestock, equipment, and personal objects (mainly jewelry) in ownership. The human asset characterizes women's education, training, and experiences and is part of personal empowerment. "Women's empowerment" refers to the participation of women in the decision process at the household level. The last theme concerned women's contribution to household economic participation, farm expenses, and income generation.

The second step consisted of gathering the variables according to the nature of capacity at the household farm level by distinguishing physical assets (land, livestock, and equipment), human assets (family composition, off-farm activity, education), and monetary fluctuations (including expenses and incomes given as a proxy of overall economic livelihoods).

The third and last step aimed at examining the levels of women's capacity in terms of involvement, empowerment, and endowment influence (or their links to) the household farm livelihood based on farm and household assets, human assets, and monetary fluxes. A multiple factorial analysis (MFA) was used to analyze the causal or correlational links between the different themes. The MFA allowed the comparison of links between

themes corresponding to the other groups of variables [24,28,29]. All the themes considered in the analyses are in Table 2. Finally, a hierarchical clustering analysis (HCA) was implemented on the two first factorial axes of the MFA to describe the different profiles of women's contributions to the household farming systems capacity (referring to the Ward approach [30]).

3. Results

3.1. The Descriptive Approach of Household Farm Systems by Zone

Table 3 shows the five zones' main descriptive statistics of farms, households, and housing conditions. The zonal discriminant factor of the physical asset was the flock size between the mountainous zones in the northern and southern sides of the High Atlas (z1 and z2), where sheep and goat flocks were around 18–25 heads on average, and the other zones had only 5–10 animals. Irrigation was the most developed in the palm tree systems of the oasis (z5), where it is also observed to have the highest parcellation (with 5–6 parcels on average). The farm households in the plain of Souss (z3) were the most equipped, with 10% having a tractor, and z3 also recorded having the highest level of employability in the agricultural sector. Around 75% of working-age family members worked on the farm, and 35% employed as occasional workers on other farms. The highest farm incomes were recorded in z2, covering the Oued Souss watershed with a flourishing irrigated agriculture oriented to vegetables and fruit trees. Thanks to their proximity to cities (like Taroudant or Marrakech), zones 1 and 3 record significant off-farm incomes, mainly due to women's wage employment in agricultural tasks in zone 3 and touristic activities for men in zone 1. The farm incomes generated by women were the highest in zone 2, mainly linked to argan exploitation.

Table 3. Descriptive statistics of household farm assets in Southern Morocco (285 households, Household survey 2016).

Variable Names	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Number of household farms	60.00	60.00	60.00	45.00	60.00	285.00
Land ownership (ha)	2.18	1.56	1.10	2.49	1.74	1.78
Parcels (nb)	3.35	5.05	1.33	2.76	5.60	3.66
Traditional *melk* (land ownership) (%)	75%	66.67%	40.33%	44.89%	48.82%	55.68%
Rent land (ha)	0.33	0.22	0.67	0.47	0.80	0.50
Cultivated area (ha)	2.26	1.81	1.60	1.45	1.64	1.77
Irrigated land (%)	31.72%	22.46%	11.25%	13.77%	59.03%	28.54%
Cattle (nb)	1.47	1.90	1.38	0.51	0.60	1.21
Sheep and goats (heads)	17.85	24.52	4.42	9.82	5.18	12.49
Chicken and ducks (heads)	5.12	4.48	3.55	3.89	0.65	3.52
Tractor (% of owners)	0	0	10	0	0	2
Car (% of owners)	8	3	13	16	8	9
Motobike (% of owners)	23	17	25	16	37	24
Television (% of owners)	107	107	130	124	120	117
Family members (nb)	6.65	5.83	5.83	5.71	9.88	6.84
Dependant members (nb)	5.75	5.82	5.62	5.51	9.43	6.47
Family farm labor (%)	30%	47%	75%	56%	87%	59%
Occasional agricultural workers (%)	0%	18%	35%	9%	0%	13%
Salaries in the private sector (nb)	1.07	0.95	0.75	0.84	0.52	0.82
Salaries in public sector (nb)	0.02	0.05	0.08	0.04	0.03	0.05
Education of family head	1.85	1.88	1.68	1.93	2.42	1.95
Age of family head (years old)	51.80	45.75	35.22	19.04	53.00	42.12
Farm net income (Dh)	30,997	39,298	32,720	6881	29,298	289,42
Off-farm net income (Dh)	22,223	3820	20,876	17,777	16,190	16,093
Total family net income (Dh)	53,220	43,118	53,596	24,657	45,489	45,035
% women contribution to off-farm net income (%)	15%	3%	43%	14%	2%	15%
Women farm net income (Dh)	16,163	21,265	8424	4195	2185	10,775

3.2. Women's Capacity Assessment per Zone

3.2.1. Women's Asset Ownership

One of the first and fundamental issues of women's endowment that was often mentioned was the low access to physical assets. Table 4 gives the types of ownership women can access in the study zone. Globally, the main physical asset owned by women was trees, mainly fruit trees like olive trees, for family consumption. Only 9% of women owned private land, and 12% had indivisible land ownership (land collectively owned). Women's land ownership was highest in the oasis (z5), where around 25–30% of women owned land; the land size, however, remained relatively small (<1 ha) compared to the Northern anti-Atlas. However, the particularity of the Oued Souss (z3) women who also owned cattle and goats is noticeable.

Table 4. Women ownership of assets (in %, a sample of 285 women).

Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Sheep ownership (% of women)	0	0	5	5	5	2
Goat ownership (% of women)	2	3	22	2	7	7
Cattle ownership (% of women)	0	2	15	7	2	5
Poultry ownership (% of women)	0	0	3	13	3	4
Tree ownership (% of women)	53	18	87	85	67	65
Individual land ownership (% of women)	5	0	10	9	23	9
Collective land ownership (% of women)	0	0	17	9	32	12
Av. size of collective land ownership by women (ha)			2.39	2.75	0.83	1.53
Av. size of Individual land ownership by women (ha)	0.19		1.12	8.13	0.78	1.88

3.2.2. Women's Involvement in Domestic and Farm Activities

To assess women's involvement in domestic or social activities and farm or off-farm activities, the declaration of time (in terms of hours and days) is used to allocate each activity during the year. Knowing that domestic or social tasks are not valued in monetary terms, the economic contribution through their time investment was encompassed in the declared household economy for the respective domains, i.e., 'women's time devoted to domestic and social tasks' in Table 5.

The total time devoted to domestic and social tasks corresponded to nearly a full-time job of 8 h per day in zones 2 and 4 and two full-time in zone 1 due to a significant time allocation to "culture" (Table 5). The activities related to social tasks embedded the women's time participation in religious and spiritual activities, family or community events (e.g., births, weddings, festivals called 'moussems', etc.), receiving or visiting neighbors and families, etc. These social activities corresponded to the primary time allocation of women in the North Anti-Atlas (z4) and the second time allocation after food preparation in the Northern side of High Atlas (z1). The time to transmit agricultural knowledge was the highest in the mountainous zones (mainly z1 and z2). This time devoted to know-how knowledge can be related to the isolation and biodiversity of these zones. Isolation leads to the need to live on the local resources and thus explore and valorize the biodiversity. Women usually shoulder this activity, and the common lands dedicated to forests or pasturelands register higher biodiversity than the agricultural zones.

Regarding farm activities, women's involvement was the most important in raising activities, with a high percentage in the agropastoral zones of High Atlas (z1 and z2) and the ant-Atlas (z4). The main cropping activity was harvesting. Unlike men, women are rarely hired as agricultural workers. Their contribution belonged to the non-paid family labor domain. The milking species were goats and cattle. Grazing was conducted for the

medium-to-large flock. In addition, few women are declared involved in crop activities except harvesting or weeding.

Table 5. Descriptive statistics of women's participation in the different domestic tasks (in hours per week) or farm activities (in % of the total time required by the activity) (sample of 285 women, household survey 2016).

Women Contribution to	Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa
Women's time devoted to domestic and social tasks (in hours/weeks)	Crafts activities	6.9	2.8	0.5	2.5	0.4
	Culture	15.1	0.0	0.0	10.0	2.7
	Care (children, elderly, sick)	0.0	0.8	0.1	6.1	1.8
	Preparing food	27.0	20.6	5.5	5.3	4.8
	Transmission of agricultural knowledge	8.3	13.0	2.8	7.1	0.5
	Biodiversity maintenance	0.0	0.9	0.0	0.2	0.9
Contribution of women to... (% of women who contribute to respective crop activity per zone)	Planting	4	2	4	0	2
	Tillage	5	5	3	0	2
	Tree irrigation	4	2	4	0	1
	Tree pruning	3	3	3	0	1
	Fertilizing trees	3	0	2	0	1
	Fruit harvesting	7	13	4	5	1
	Fruit marketing	4	2	3	2	1
	Sowing	3	3	4	0	1
	Tillage for annual crops	3	3	4	1	1
	Irrigation for annual crops	3	2	4	3	0
	Fertilization for annual crops	3	0	4	0	1
	The harvest for annual crops	4	15	8	5	0
	Sales for annual crops	3	1	2	0	1
Contribution of women to... (% of women who contribute to respective livestock activity per zone)	Stable cleaning	67	84	23	58	6
	Animal feed	66	83	24	59	8
	Grazing	36	45	15	40	4
	Birth	44	32	18	50	4
	Animal care	36	12	18	47	3
	Milking	33	39	15	19	4
	Protrusion	31	25	13	28	4
	Sale of animals	8	1	14	30	0

3.2.3. Women's Empowerment

Table 6 shows the women's involvement in decision processes through their participation in decision processes (advice, discussion) and decision-making (when women made the decision themselves). In the North Anti-Atlas (z4), women were the most involved in household farm management at the decisional level compared to the other zones. This involvement can be correlated to their significant contribution to load work in farm activities and income generation through off-farm activities. Conversely, in the mountainous zones of the High Atlas, women were highly consulted during the decision processes, although men mainly made the decisions at the end. The lowest contribution was noted in the oasis zone (z5), where the women are the least involved in economic activities.

Table 6. Women's participation in giving advice or making decisions (%) (285 women survey, 2016).

Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Advise on agriculture	80	30	25	78	10	43
Advise on breeding	80	45	27	82	22	49
Advises on domestic expenses	90	52	73	87	40	67
Advises on household management (on six items)	88	47	75	87	90	77

Table 6. *Cont.*

Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Decision in agriculture	12	7	12	33	3	12
Decision in breeding	13	8	7	33	8	13
Decisions on domestic expenses	17	8	42	38	13	23

3.2.4. The Economic Contribution of Women at the Farm Household Level

Two components addressed the economic contributions of women at the farm household level, i.e., (1) the financial support of women approached by their monetary contribution to the household and farm expenses or incomes (Table 7), and (2) the fluctuations of transfer from and to women at the household level, which denote both amount of money generated and given to women (Table 8). Firstly, women's financial contribution within the farm household is the highest in the Oued Souss zone (z3) due to their significant involvement as occasional agricultural workers on large-scale farms oriented to fruit trees or vegetables for the market. Women make substantial contributions to on-farm activities in harsh environmental zones (z1, z2, and z4). These zones, dominated by extensive agropastoral systems in the mountainous areas, had known a critical rural exodus of the men (as identified by local leaders in the qualitative interviews). Therefore, the women were fully involved in farm activities to maintain the land and livestock assets.

Table 7. Monetary contribution of the women to the farm household economy in % of the household expenses or income (285 households, 2016).

Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	*Average (All Zones)*
Contribution of women to current household expenses	1.1	1.8	6.2	4.2	0.7	2.9
Contribution of women to equipment expenses	17.2	1.7	18.6	13.5	0.3	10.3
Contribution of women to non-farm income	15	3	43	14	2	15
Contribution of women to farm income	52	54	26	61	7	37

Table 8. The average participation of women through social and economic transfers in the monetary household economy (in Dh per year, 1 Dh = 10.10 USD in 2016) and the percentage of women involved in monetary exchange (%).

	Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Average values only for the women who give or receive a monetary amount	Income transfer to women (retirement, social benefits, rental, allowance, cash transfers, etc.)	14,280	9000	13,500	16,500	39,000	15,495
	Amount of income transferred by women in the household	650	8000	4991	- -	- -	4704
	Amount of income from the cooperative transferred by women into the household	- -	- -	1644	- -	- -	1644
	The amount received by women from the husband	220	194	2073	450	95	462
	The amount received by women from the household	128	765	467	310	100	374
	The amount received by women from the rent of their lands	2367	- -	9250	- -	1000	4433

Table 8. *Cont.*

	Variables	z1. The Northern Side of High Atlas	z2. The Southern Side of High Atlas	z3. Oued Souss	z4. North Anti-Atlas	z5. Oasis of the Middle Draa	Average (All Zones)
Percentage of women involved in monetary exchanges (in %)	Income transfer to women (retirement, social benefits, rental, allowance, cash transfers, etc.)	8	2	13	11	2	7
	Amount of income transferred by women in the household	5	2	52	0	0	12
	Amount of income from the cooperative transferred by women into the household	0	0	20	0	0	4
	Amount received by women from the husband	58	28	20	11	28	30
	The amount received by women from the household	15	17	5	11	10	12
	The amount received by women from the rent of lands	5	0	3	0	2	2

Contrary to Oued Souss zone (z3), where around 52% of women transferred the remuneration of their occasional jobs to the household, women in mountainous zones (mainly z1, z2, and z4) received monetary support from their husbands to pursue farm activities (Table 8). The social and economic transfers from family members living out of the house also reflected this difference between mountainous and plain zones. On the other hand, the oasis zone (z5) constituted an exception, with few or even no women involved in farm activities. The reasons referred to the oasis system with palm trees requiring specific know-how that men often held and this zone's cultural and religious norms, which prohibited women from participating in farming.

3.3. Women's Contribution to the Overall Household Farm Livelihood

The previous results showed the contrasting contributions of women to household and farm activities in terms of time involvement, empowerment or decision-making power, or asset ownership according to the agro-geographical zone. Here, it is proposed to simultaneously analyze the correlational links between household farm livelihood and women's contribution through time involvement, empowerment (decision-making), and endowment for assessing their socioeconomic contribution to household outcomes.

A multiple factorial analysis has been implemented based on the data split into different themes. All the quantitative and qualitative data have been codified. The variables related to the capacity at the household farm level were grouped into three themes: (1) physical assets related to land, livestock, and housing ('HH_Asset'), (2) human assets ('HH_Human') related to family composition and educational level, and (3) monetary flow capacity ('HH_income'). They were considered supplementary variables. All the themes (groups of variables) related to the women's contribution were active. They are split into six themes (as presented in Table 2) called partial groups.

In the first factorial plan, the projection of partial groups underlines the differentiation of women's capacity according to their socioeconomic contribution, i.e., 'W_income' and 'W_asset' on the first factor (F1), and their time involvement, i.e., 'W_task' on the second factor (F2) (Figure 2). Overall, the significant contribution of the human asset ('W_Asset_Human') in the first factorial plan (F1*F2) is noted.

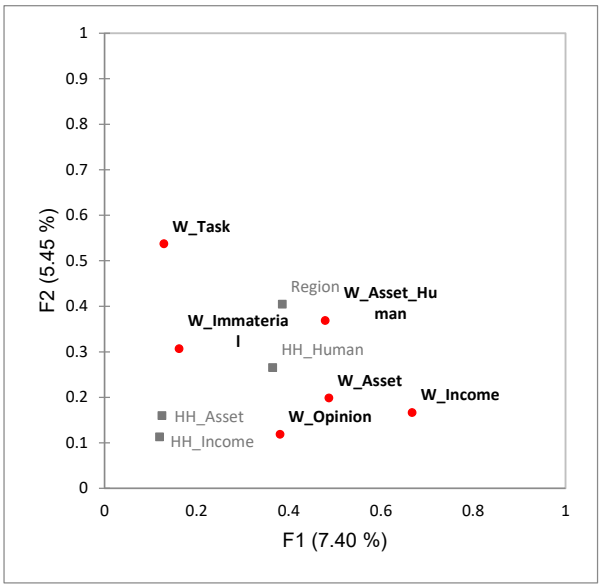

Figure 2. Projection of partial groups on the first factorial plan (F1*F2) (F1 and F2 representing 12.8% of the variance; in bold the active themes and in no bold the supplemental themes in the Multiple Factorial Analysis).

Table 9 shows the links between the ten groups of variables. Firstly, the multidimensionality of the group 'W_Asset_Human' is confirmed, revealing the significant correlation between the human asset of women and the human asset at the household level, which in turn would have positive links with the household assets and income. Secondly, the significant correlations between women's physical and human assets and their socioeconomic contribution to the region are noted. Finally, this analysis highlights the substantial link between women's time in domestic activities and the human assets at the household level. Conversely, the time allocation between domestic and farm activities or women's income had few links with the overall household livelihoods.

Table 9. Correlations between the assets and women's capacities (Lg coefficients measuring the covariance between each group of variables).

	W_Task	**W_Immaterial**	**W_Asset**	**W_Asset_Human**	**W_Opinion**	**W_Income**	**HH_Asset**
W_Task	1.571	0.145	0.096	0.188	0.094	0.262	0.238
W_Immaterial	0.145	2.025	0.249	0.424	0.099	0.209	0.367
W_Asset	0.096	0.249	3.060	0.583	0.135	0.338	0.337
W_Asset_Human	0.188	0.424	0.583	6.842	0.271	0.481	0.476
W_Opinion	0.094	0.099	0.135	0.271	1.427	0.226	0.131
W_Income	0.262	0.209	0.338	0.481	0.226	2.298	0.277
HH_Asset	0.238	0.367	0.337	0.476	0.131	0.277	3.135
HH_Human	0.265	0.428	0.440	1.308	0.273	0.691	0.741
HH_Income	0.166	0.277	0.281	0.475	0.135	0.318	0.855
Region	0.273	0.789	0.595	0.858	0.392	0.665	0.829
AFM	1.023	1.368	1.937	3.816	0.978	1.656	0.793

Figure 3 results from a hierarchical clustering analysis based on the two first factors of the MFA. The clustering analysis allowed us to identify the differential roles of women between types 2 and 4, where women contributed significantly to expenses and incomes, and types 1 and 3, where women had the lowest economic contributions. Women in type 2 were involved in farm and off-farm activities, although women in type 4 derived their incomes from their assets, notably trees, sheep, and goats. However, there is also a second differentiation according to the time involved in domestic or external activities. Women in types 1 and 2 were the most involved in domestic, livestock, and immaterial activities, such

as local knowledge transfer, culture transmission to children through cooking or songs, and biodiversity maintenance through local know-how. They also participated in most of the decisions regarding household or farm activities. Type 2 was also the type where women make some decisions. These considerations were essential as the type of decision was highly gendered.

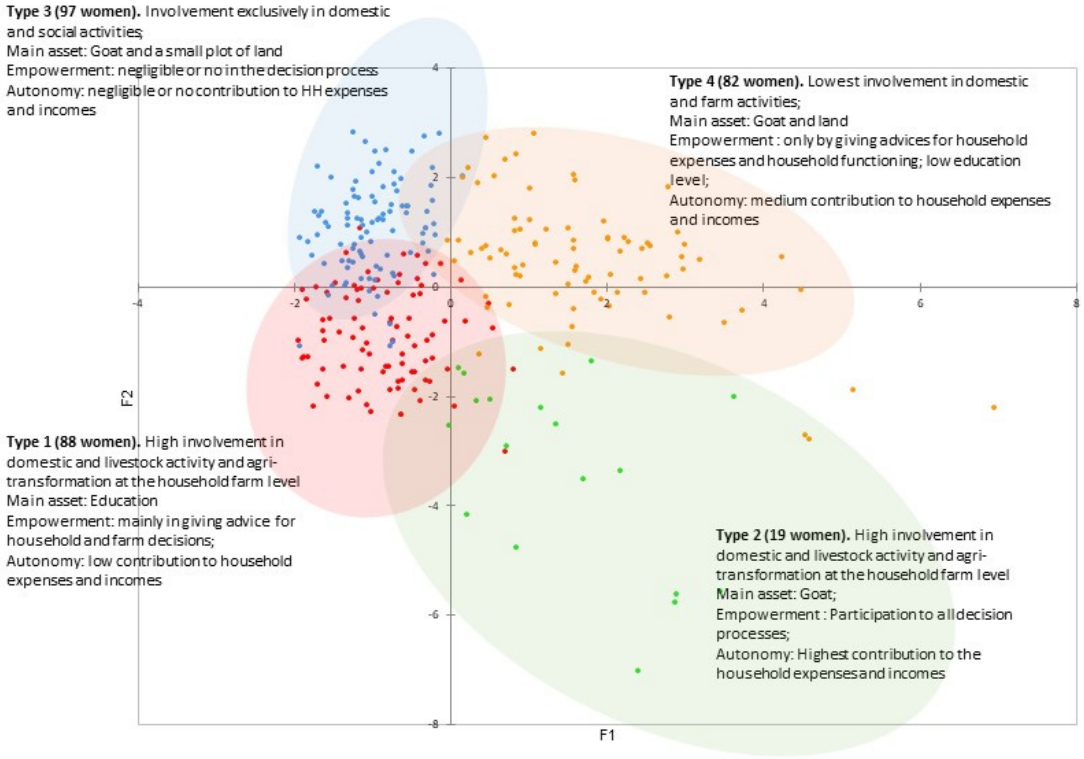

Figure 3. Classification of women groups through a hierarchical clustering analysis using XLSTAT Software, Addinsoft, version 3.0) (Legend: the contour of each cluster is the confidence ellipse with an interval of 90%; each cluster is represented by one color).

However, when exploring the link between women's capacity and the household farm system, women's socioeconomic contribution appears to be the highest in low-income households (Table 10). These findings suggest that women predominantly managed households with the highest poverty levels and that they did so out of necessity.

Table 10. Characteristics of the household for each woman's type (285 households, 2016).

Valeurs	Type 1	Type 2	Type 3	Type 4	Av. Sample
Owned land (ha)	2.3	1.4	1.3	1.8	1.8
Ownership in Melk (%)	79.7	58.3	47.1	39.5	55.7
Irrigated land (% of the cultivated area)	29.6	33.6	38.3	14.1	28.3
Number of trees	55.8	40.0	60.5	23.1	47.0
Number of sheep and goats	26.3	10.3	7.2	4.5	12.5
Number of cars	0.1	0.0	0.1	0.2	0.1
Number of dependant members in the family	6.0	5.4	7.5	6.0	6.5
Average education of women at the HH level	1.4	1.4	1.2	0.5	1.1
Average education of men at the HH level	2.0	1.1	1.5	0.8	1.4
Farm net income (Dh/year)	36,911	21,763	33,682	16,357	28,942
Off-farm net income (Dh/year)	15,254	14,012	12,984	21,128	16,093

4. Discussion

4.1. Women's Contributions and Roles and Their Benefits

The analysis of women's capacity regarding physical assets, social and human assets, and economic contribution in terms of labor or monetary fluxes reveals the diversity of women's contribution to overall household livelihood according to agroecological zones.

Firstly, our findings revealed significant gaps in land ownership between the five zones, with the highest rate of ownership in the oasis zone on a tiny land area (around 0.8 ha) and the highest owned land area in zone 4 (anti-atlas) mainly due to the harsh environment in the zone. The lowest rate of land ownership by women was noted in the mountainous zones (zones 1 and 2). Tree plantations occupy the majority of these lands owned by women. These findings linking tree ownership with property rights for women are novel and have not been reported in the published literature on the MENA region. Women primarily owned goats and cattle for milk production, particularly in the Oued Souss region, where animals could benefit from crop residues. Additionally, women involved in off-farm activities could use their income to invest in animal assets. These results confirm several pieces of evidence on the gender gap in asset ownership and wealth (already well documented by Kilic et al. 2016 [31]) by referring to the northern countries in Sierminska et al., 2010, or Ruel and Hauser, 2013 [32,33], or to the developing countries [18,34]. However, they also question the rights to assets. For example, on average, 12% of women share land with other family members.

Secondly, the assessment of women's involvement in domestic and farm or off-farm activities in time allowed us to capture women's participation in domestic activities that were difficult to value by themselves and the economic fluctuations from and to women due to their time investment and funds received that were encompassed in the household economy. On the one hand, women's involvement in agricultural activities revealed gendered and geographical gaps in farm tasks in the studied areas. For example, most women took care of animals at the farm. At the same time, crop activities were mainly male activities, even if women were involved in harvesting annual or perennial crops (from interviews). So, land cultivation remains the main activity of men, whereas animal raising is mainly a task for women. On the other hand, there are variations in women's involvement in agricultural tasks between the zones. In the oasis zone, women contributed the least to farm activities. Here, women's cloistering was still considered one of the characteristics attached to wealth and prestige [26], and their involvement did not exceed 6%, even for animal activities. On the contrary, in the mountainous zones of High Atlas, between 66 and 84% of the women were involved in the daily care of the animals, especially in stable cleaning and animal feeding, and even 36–45% in managing grazing activity on collective lands. Overall, Abdelali-Martini (2011) and Najjar et al. (2018) showed a sharp increase in female employment in agriculture from 29% in 1980 to 38.9% in 1995 to 47.7% in 2010 in Morocco, while men's contribution to agriculture decreased considerably from 66 to 55% between 1995 and 2011 [21,35]. Our results confirm this trend, especially in mountainous zones with the highest level of men's migration towards the urban zones. This outmigration was also observed in Egypt, where women increasingly worked on their land or as laborers on land owned by medium or large-scale farms in irrigated lands that are more intensive in work [36,37].

Thirdly, the present results confirm that most rural women received no income due to their farm work. By adding the total time devoted by men and women on the farm, the women contributed 37% of farm activities, rising to 52–54% in the mountainous zones. However, the income transferred to the household did not exceed 12% and was down to 2–5% in the mountainous zones. These results confirm the expected results for rural women in small farms [38,39], i.e., the fragmentation of the social space that articulates gender

differences and access to the monetary economy. The issue of women's financial exclusion is an essential topic in the gender literature [11]. Moreover, Moisseron et al. (2019) showed that, outside the Souss Plain, women's contribution to non-agricultural income was almost nil on the southern slopes of the High Atlas (3 percent) and in the oases of the Middle Draa (2 percent) [11].

Finally, concerning the women's involvement in the decision-making at the farm and household levels, the results showed that the gaps remained the most pronounced in livestock activities despite their significant work contributions. These findings are surprising, knowing that women own livestock, mainly sheep and dairy cattle, but seem unable to control related income. However, in the anti-Atlas zone, where women were the most involved in farm activities and farm income generation through off-farm activities, around 30% declared they participated in the decision process related to farm activities compared to 12% on average in the studied zone. On the opposite side, in the mountainous zones of the High Atlas, even if the women were extensively anchored during the decision processes, the men mainly made the decisions in the end. The lowest contribution is pregnant women in the oasis zone, where there was little involvement of women in economic activities. In summary, the present results confirm that the economic involvement of women does not suffice to ensure autonomy and empowerment. They emphasize that women's empowerment is highly contextual and dependent on cultural structures of constraints and limitations and goes beyond material acquisition, as observed in the oasis zone. As mentioned in different research works [40,41], the assumption that empowerment can be gained through economic development is not systematic. Even if the contextual and cultural factors are essential, women's lack or weak influence on decision-making is also related to differential access to education and social or administrative services. Women's empowerment is a more multi-dimensional process of civil, political, social, economic, and cultural participation and rights, as proposed by Moghadam, V. M., and Senftova (2005) [42].

4.2. The Overall Contribution of Women at the Family Farm

The results showed that the women are fully involved in farm activities to maintain the land and livestock assets at the household farm level, except in the Oasian zone. However, contrary to the Oued Souss zone, where around 52% of women transferred the remuneration of their occasional jobs to the household, women in the mountainous zones received monetary support from their husbands to pursue farm activities (Table 8). The social and economic transfers also highlighted this difference between mountainous and plain zones. Moreover, the overall gaps between labor involvement and participation in the decision process for women confirm that economic (and even financial involvement) in or out of farms does not ensure total equity in the decision process (similar findings were reported in Syria [43]).

From the cross-analysis between women and family farm capacity, the correlation revealed a strong link between women's human assets and household assets at the household level, which would positively affect household assets and income. This finding synthesized in Figure 4 reveals women's crucial roles in intergenerational knowledge transfer. Significant correlations between women's physical and human assets and their socioeconomic contribution at the regional level are also noted. Finally, there is a substantial link between women's time in domestic activities and human assets included in immaterial activities at the household level. Conversely, the time allocation between domestic and farm activities or the women's income had few links with the overall household capacities.

The clustering analysis showed that the women who were the most involved in domestic, livestock, and immaterial activities (such as in types 1 and 2) generally participated in most household or farm activity decisions. These considerations are essential as this type of

decision is highly gendered. Women's economic contributions to household reproduction are seen to be both critical and separate from men's [44].

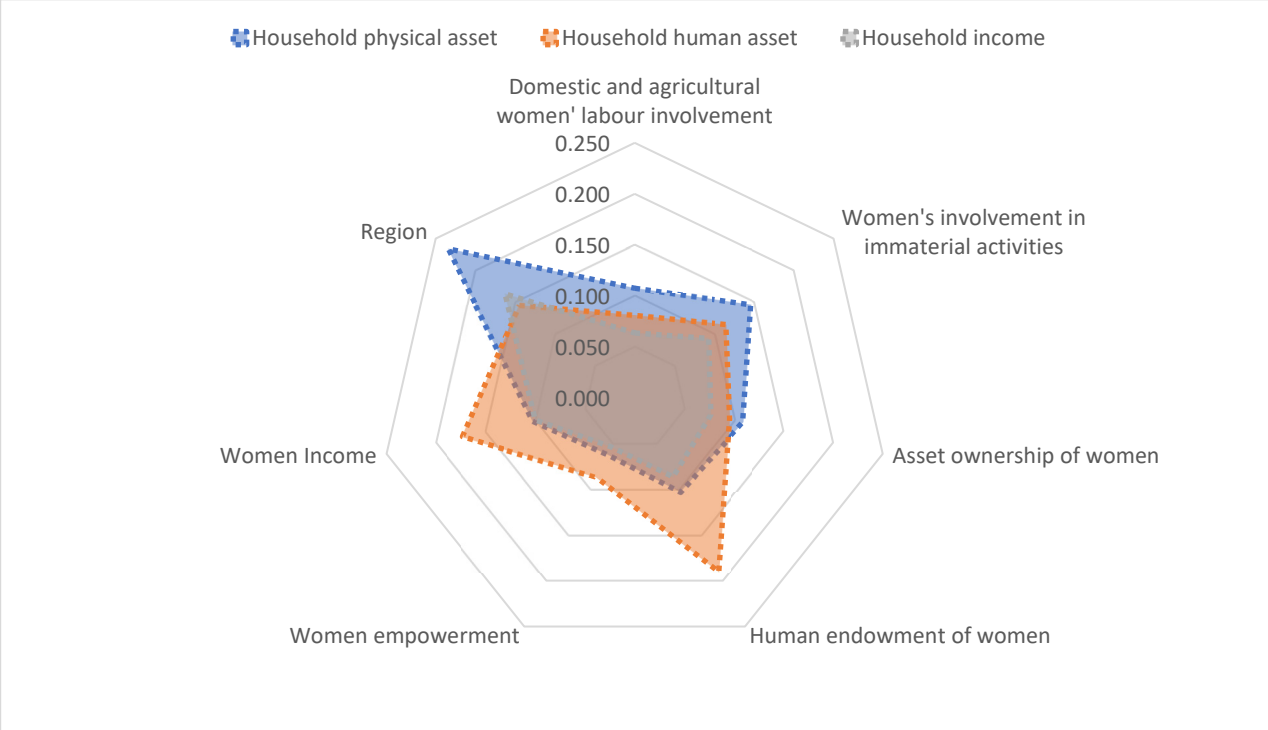

Figure 4. The link between women's capacities and household capacity and monetary livelihood (based on the Lg coefficient, see Table 9).

However, complementarity observations in the studied zone through interviews also showed that the material and immaterial dimensions of women's activities in rural areas are often merged and challenging to separate, given their intertwining nature. For example, when working in the field or at home, women transmit a wide gamut of technical and immaterial knowledge to their daughters and sons. It is difficult to distinguish and, especially, to assign different values to the tangible and intangible aspects of the diverse activities undertaken by rural women. The latter plays a unique role in transmitting know-how and cultural heritage. In the present paper, one of the assumptions has been to consider the transfer of knowledge in terms of time involvement, which is a debatable proxy. Another option would have been to consider the impacts of the next generation. Whatever the approach, the results show that means must be found to make this local knowledge known and valued, whether cultural (stories, songs, etc.) or economic (crafts, food processing, etc.). This dynamic must also include a form of valorization of the women themselves and their identity.

What also emerges from the surveys and interviews is that participation in a cooperative is a determining factor in access to income and probably to greater social capital. The women's cooperatives are sometimes the only places where women have a social life outside the family and can also gain income. These cooperatives can serve as a springboard for women's empowerment and, particularly, financial autonomy. The latter refers to setting up individual savings or credit tools adapted to women, as well as training that is useful to women and meets their needs.

In particular, it would be a matter of promoting various modes of female collectives, not only in the form of standardized cooperatives, but also through the promotion of systems adapted to their territory and to the expectations of women. Such systems (e.g., collection and marketing circuits for organic food products) of various statutes would

likely support projects for structuring an agroecological sector in mountain areas and near cities. Such a sector, with moderate pricing and the valorizing of women's know-how in the field, of local and /or organic products, could have strong leverage effects on local populations if care is taken to ensure that most of the added value is not largely captured by intermediaries or private and urban investors. The crucial question of food quality, in connection with health and the maintenance of agriculture traditionally practicing (without knowing it) techniques close to those advocated by agroecology, is an opportunity to be seized for these marginal areas of Morocco and their populations, especially women.

If there is political will, it should be possible to take a significant step forward in Morocco by allocating the necessary financial and human resources. Currently, in rural areas, the fact that a woman works (or not) is not directly associated with her schooling or her level of education. Better training does not mean better activity rates for these women, on the contrary. The skills required for the work they can do rarely come from school. They are mostly passed on between generations, within the family unit, and on the family farm.

There are indicators—or rather ferments of change—that could lead to a rapid transformation of the situation of these women. A certain number of them show a desire for training or integration into cooperative structures, which makes it possible to increase their "capabilities", accumulate social capital, or create links (also shown in other contexts in Europe [45,46]. From this point of view, the technological revolution is already changing the situation. Indeed, 181 of the women surveyed have a cell phone. This is a real technological and, above all, sociocultural (r)evolution that encourages people to learn to read and count, which tends to build individuality by assigning a personal telephone number and possibly by paying a bill or a telephone recharge. The cell phone breaks the isolation and allows the consolidation of social links that are no longer limited to the douar territory. It is also a powerful vector for building individuality.

5. Conclusions

Firstly, the present research enriches the theoretical understanding of women's roles in rural household farming systems by highlighting their multidimensional contributions beyond economic metrics. It integrates gender dynamics into adaptive capacity and livelihood frameworks, emphasizing intergenerational knowledge transfer and the sociocultural aspects of women's involvement, which are often overlooked in existing adaptive capacity models.

Notably, the findings underscore how women in rural zones are in a non-market productive economy, inserted in production logics that make them have very little autonomy within the family or the community. However, the contribution of women to the family farm capacity through their know-how opens alternative pathways to reconsider and valorize their contributions to the overall goal of livelihood improvement. Moreover, the involvement of women in cooperative and associative structures reveals their commitment to take up the challenge of poverty in their household and to seize the decision. These cooperatives can serve as a springboard for women's empowerment and a certain financial autonomy. Such collective systems could likely support projects for structuring innovative sectors such as agroecological business models in mountain areas and near cities. This should be more considered in the development policies in these vulnerable rural zones. Therefore, the present paper opens a new area of investigation related to the agricultural systems and social promotion and innovation through collective actions.

However, the study's focus on a specific geographical area in Morocco limits the generalizability of its findings, so they may not be applicable to other contexts or regions with differing socioeconomic and cultural dynamics. Moreover, in gender studies, the household survey approach may introduce biases in capturing all the components of

women's contributions and perceptions of decision-making. So, integrating longitudinal data and mixed methods approaches could provide deeper insights into the evolving roles of women, the impact of their empowerment over time, and the interplay between material and immaterial contributions.

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Institutional Review Board Statement: The household surveys have been done with the oral consent of the persons involved in the survey after introducing the objective of the study and the content of the questionnaire.

Data Availability Statement: The questionnaires of the study can be found in https://amu.hal.science/hal-04871982.

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