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Working Paper

Women's Empowerment in Agriculture for Nutritional and Food Security Benefits in Tajikistan: Latent Analysis Approach

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Abstract

Although women play an important role in developing countries, they face persistent social and economic constraints limiting their inclusivity in household decision-makings. The Asian enigma, the case in which economic growth is not followed by expected improvements in nutritional outcomes, states that women's low social status is to blame. This paper sheds some light on the issue by studying the linkages between the Women's Empowerment in Agriculture Index (WEAI) and food security indicators in Tajikistan by using population-based survey in Tajikistan with 2000 households. We apply a latent class approach to represent the relationship between the most disempowering domains and nutritional or food security outcomes. Accordingly, women's empowerment in the *purchase, sale, or transfer of assets* has a positive association with improved diet diversity of children. As for food security outcomes, higher women's empowerment in *autonomy in production* has a relationship with improved household hunger. Findings clearly indicate that *group membership* is one of the most promising areas for policy intervention. Precisely, group membership-based women's empowerment is associated with better diet diversity, decreased number of stunted children and improved household hunger. Considering findings for nutritional outcomes, women's empowerment and different anthropometric measures have messages for further policy formulations to enhance nutrition-sensitive approaches.

Key Words: Women's empowerment, food security, latent analysis, hunger

JEL: Q18, O13, P36, E21

1. Introduction

A major role of women's empowerment can be seen in inclusion, which involves different interventions through equal access to resources and decision making. Issues in relation to development, where there is a consideration of women's inclusivity, can be solved by strengthening the role of women in the decision-making process (Mutimukuru-Maravanyika et al., 2017). Therefore, the promotion of empowerment of women by increasing their decision-making and participation determines opportunities to improve food security (Harper et al., 2013); however, there should still be related studies describing the nature of women's empowerment to improve both maternal and child nutritional outcomes (Kadiyala et al., 2014; Rao et al., 2019). Many papers focus on the relationship between agriculture and nutrition (Kadiyala et al., 2014), in which there are two leading pathways mentioning the role of women to support nutrition-relevant resource allocation and adequate child feeding (Gillespie et al., 2019). In this case, the majority of findings for gender equity in nutritional-sensitive agriculture claim that women generally lack access to and control over resources (Akter et al., 2017). At this point, it is important to look again at how empowerment is unlocked in agricultural production and decision-making for improving nutritional outcomes.

In order to understand the level of empowerment in agricultural activities, the evidence base for agricultural interventions should be established in fighting malnutrition (Fiorella et al., 2016), where empowerment and nutritional improvement are congruently interlinked under nutrition-sensitive agriculture (Johnston et al., 2018). With special attention to the scope of nutritional-sensitive agriculture, existing literature uses the Women's Empowerment in Agriculture Index (WEAI) as one of aggregate measure (Alkire et al., 2013). This method allows for understanding related disempowerment domains that reflect overlapping achievements in realizing women's role in agriculture (Gupta et al., 2019b). A progress measurement of empowerment through WEAI has become quite amenable by defining where gaps in empowerment exist, indicating women are generally twice disempowered as men (Malapit et al., 2014b). Women's disempowerment situation pursuant to WEAI domains explains an irreversible impoverishment of maternal and child nutrition (Malapit et al., 2015), dietary quality (Sraboni and Quisumbing, 2018), nutritional outcomes (Holland and Rammohan, 2019; Malapit and Quisumbing, 2015), food security (Sraboni et al., 2014a), and iron deficiency (Gupta et al., 2019a). However, discussions about women's empowerment in agriculture based on the WEAI framework show that intra-regional heterogeneity exists

indicating the need for further analysis from different regions and traditions (Akter et al., 2017; O'Hara and Clement, 2018).

As mentioned, tailoring the WEAI should be regional context (Gupta et al., 2019b), this paper uses findings from one of the most poorest region of Tajikistan. To understand the role of WEAI, we include both child and maternal nutritional outcomes together with household hunger conditions. Second, by applying the Latent Class Approach, we can contribute to the technical understanding of the WEAI. As long as each indicator of WEAI is divided into different defining statements or survey questions (Alkire et al., 2013a), we can observe multiple statements, perhaps all, to define whether women are empowered in certain domain. In this case, a latent variable to represent the extent of empowerment in corresponding domains is mutually exclusive in the model (Heck and Thomas, 2015). It should be mentioned that applications of latent class analysis in studying women's empowerment provide many plausible explanations by accurately defining the multidimensionality of empowerment nature (Barth and Trübner, 2018; Mizoguchi, 2017); however, discussions by WEAI have not hitherto applied class measurement techniques for nutritional or food security discussions. Therefore, all WEAI discussions are based on *variable-centered approach*, which involves selecting one of the most disempowering variables to build the relationship between WEAI and nutritional or food security outcomes. In contrast, latent class techniques allow us to apply *a person-centered approach* in which the focus is given to studying individuals on the basis of their patterns of individual characteristics (Bergman and Lundh, 2015; Bergman and Magnusson, 1997). Therefore, the latent variable in describing specific characteristics helps to array latent classes representing more accurate response patterns against the noisy background of error (Collins and Lanza, 2009). In the regression model, we apply a three-step approach (Collier and Leite, 2017), which provides more robust results regarding parameter estimates and standard errors (Vermunt, 2010).

In this paper, our study is based on Tajikistan's rural region known as Khatlon. Relevant data from the 2000 household surveys were collected through 12 districts, where two-thirds of the population is in the lowest quantiles of its national wealth index (FEEDBACK, 2014b). The current situation for employment opportunities for women in Tajikistan is rampant, indicating limited agricultural employment under the presence of "female" jobs such as traditional cotton production (Meurs and Slavchevska, 2014). This long-term perpetuation of limited opportunities for women in agricultural activities in post-Soviet Tajikistan has become

increasingly entrenched. However, the feminization of agriculture is apparent due to male labor force outmigration (Mukhamedova and Wegerich, 2018).

2. Literature Review

2.1 Empowerment and Nutritional Outcomes

In scientific discourse, empowerment can be understood by having policy implementations to empower individuals in order to improve access to resources (Quisumbing, 2003). A broader term is related to the definition in which empowerment is explored as improving abilities to make decisions within resources, agency, and achievement dimensions (Kabeer, 1994). As the ability to exercise choice is realized through resources used by the agency (Sraboni and Quisumbing, 2018a), adherent preconditions in which financial, social, economic, or human factors enhance the ability to make choices (Kabeer, 1999). Similarly, empowerment is attributed to the possibility of making effective choices for achieving desired outcomes (Alsop and Heinsohn, 2005). Looking at more specific contexts, a number of empirical studies indicate that involvement in community organizations and activities means empowerment (Hughey and Peterson, 2004; Zimmerman, 1990). Essentially, empowerment embodies autonomy in decision making (Malapit et al., 2017; Seymour and Peterman, 2018) and balance of power in the household (Bhagowalia et al., 2012). There is, to some extent, empowerment in line with gender equality (Riley, 1997; Sreberny, 2005) but interpretations are still diverse (Bold et al., 2013; Malhotra and Ruth Schuler, 2005).

As the increasing agricultural diversity has been found not necessarily sufficient for improving nutritional outcomes (Rosenberg et al., 2018), many scientists endeavor to explain the relationship between women's empowerment and attaining nutritional goals (Madzorera and Fawzi, 2020; Sraboni and Quisumbing, 2018a). Findings are diverse, indicating that "circumstantial evidence" with respect to empowerment and nutrition pathway is needed (Nordhagen et al., 2019; Rao et al., 2019; Sinharoy et al., 2019). Pursuant to this logic, women's empowerment is explicitly recognized as one of the determining factors of nutritional improvement inhering in nutrition- and gender-sensitive agriculture (Ruel and Alderman, 2013; Ruel et al., 2018). Although domains of empowerment are translated into nutritional outcomes differently (Malapit and Quisumbing, 2015; Pratley, 2016), the term is widely regarded as one of the important spheres in accelerating the reduction of malnutrition (Larson et al., 2019; Rao, 2006). For example, there are some rigorous results in the pathway showing the linkage between women's empowerment through decision making and nutritional outcomes (Rao et al., 2019), technology adoption and diet diversity score (Kassie et al., 2020), or access to credit and food security (Larson et al., 2019). In pursuant of this purpose, empowerment in agriculture translates into better household food security (Botreau and Cohen, 2020; Galiè et

al., 2019; Lecoutere, 2017) and diet diversity (Gupta et al., 2019a; Kumar et al., 2018b). Similarly, this pathway is strongly pronounced in improving child nutritional outcomes (Santoso et al., 2019), indicating a palpable effect of women's empowerment on the reduction of child wasting (Heckert et al., 2019) and other anthropometric measures (Kumar et al., 2018a). Research also indicates that women's empowerment through participation tends to improve a child's growth. Looking at previous studies, the level of empowerment determined by participating in micro-credit programs (De and Sarker, 2011), community-based organizations (Eklund et al., 2007) and agricultural programs (Hallman et al., 2007) has a positive association with the improvement of child underweight problems.

2.2 Women's Empowerment in Agriculture Index and Nutritional Outcomes

The WEAI is a tool used to measure women's empowerment in agriculture by focusing on empowerment, agency, and inclusion (Alkire et al., 2013b). The WEAI index itself is determined by primary male and female decision makers, who are 18 years old or over (Malapit and Quisumbing, 2015).[1] The WEAI includes two main sub-indexes: (1) the five domains of women's empowerment to assess whether women are empowered across five related domains (5DE) and (2) the Gender Parity Index to measure women's empowerment relative to men (GPI) (Alkire et al., 2013b). Accordingly, 5DE weights 0.9 compared to another component, GPI, which accounts for 0.1. Focusing on the five domains of empowerment (5DE), one can see five domains related to agency and empowerment.

Domain	Indicator	Weight
Production	Input in productive decisions	1/10
	Autonomy in production	1/10
Resource	Ownership of assets	1/15
	Purchase, sale, or transfer of assets	1/15
	Access to an decisions about credit	1/15
Income	Control over use of income	1/10
Leadership	Group member	1/10

[1] The reason behind using both primary male and female respondents from each family is due to having difficulties about "headship" in the household. Moreover, the index is created from only one of following classified families: dual adult-households, only female adults, or only male adults.

	Speaking in public	1/10
Time	Workload	1/10
	Leisure	1/10

Table-1: The domains, indicators, and weights in the Women's Empowerment in Agriculture Index

Source: Alkire et al. (2013).

There is at least one indicator representing one domain; therefore, each indicator shows whether an individual has reached an adequate achievement or not. Accordingly, 80% of achievement adequacy is disposed to make women as empowered (Alkire et al., 2013b). The WEAI measurement represents index values coded 0 and 1, in which a higher value shows greater empowerment (Alkire et al., 2013b). The Gender Parity Index (GPI) also shows another important score ranging from zero to one. If it has a higher value, there is a greater gender parity. Therefore, the WEAI provides a message as to what extent women are empowered in the household (5DE) and the degree of inequality compared to the men with whom they live together in the household (GPI) (Alkire et al., 2013b).

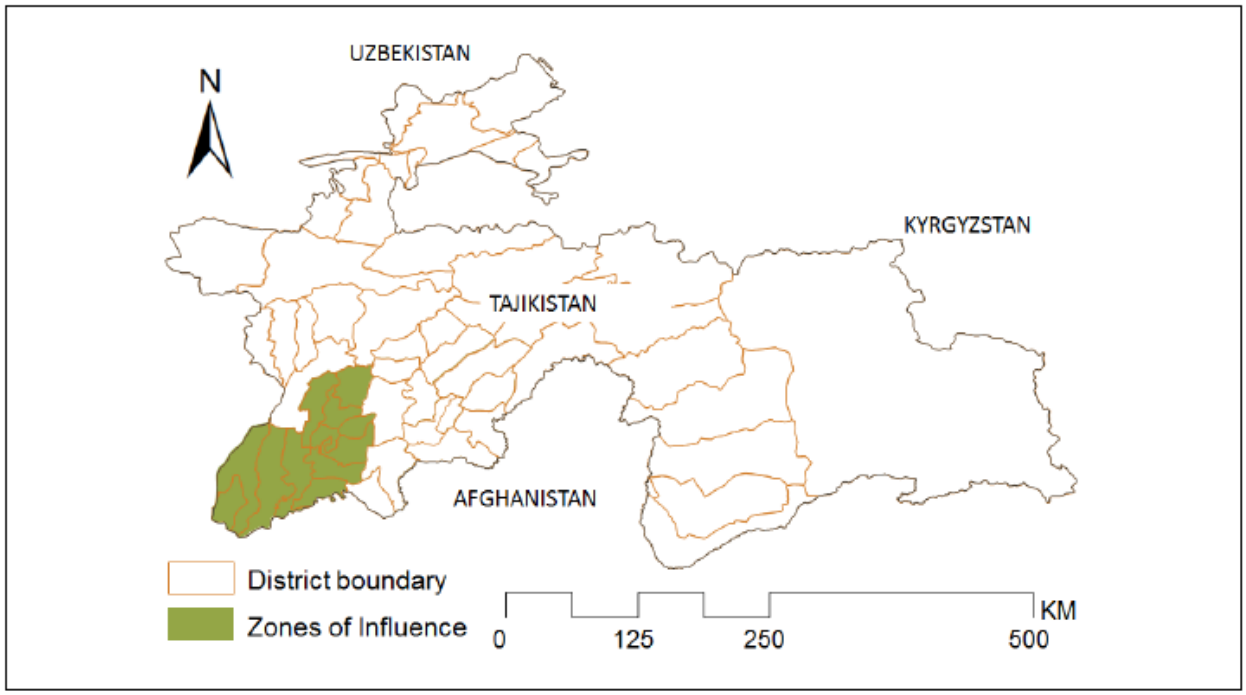
Findings with WEAI by some scholars (Malapit and Quisumbing, 2015; Sraboni et al., 2014a; Sraboni and Quisumbing, 2018b) provide salient facts about where dimensions of women's empowerment can change household nutritional balance. To be more specific, the related domain of WEAI largely determines nutritional levels in the case of Ghana (Malapit and Quisumbing, 2015). In their study, dimensions of women's empowerment affect boys and girls differently in the sense that gender parity gap has a negative association with HAZ (height-for-age Z-scores). Conversely, this study suggests that credit decisions (resource domain) may increase girl's WHZ (weight-for-height Z-scores) and women's dietary score. Additionally, Sraboni and Quisumbing (2018b) put forward relevant arguments on women's empowerment and dietary quality using survey data from rural Bangladesh. For example, both empowerment score and the number of asset decisions (resource domain) are significantly associated with the improvement of child's diet diversity for those who are under 5 years old. Another prevalent example of nutritional outcomes in this study shows that empowerment score, number of groups (leadership domain), and the number of asset decisions (resources domain) can be considered to sustain the dietary quality of children aged 5-10 years and adults. In addition to dietary diversity, empirical findings reveal the link between domains of empowerment and BMI (body mass index). A similar study from the same region clearly shows an improvement in HAZ with women's autonomy in productive decisions (production domain) and public speaking

(leadership domain) (Holland and Rammohan, 2019). Looking at the case from Nepal, empowerment indicators have a significant effect on child outcomes, where autonomy production (resource domain) can change child's dietary diversity and HAZ (Malapit et al., 2013). These results suggest that findings are generally congruent with creating a strong proxy for reducing stunting in the region. Research findings on the nutritional outcomes of adults have also provided substantive concluding remarks. For example, both engagement in the community (leadership domain) and control of income (income domain) have a positive association with maternal BMI, as shown in the case study in Nepal (Malapit et al., 2013). Likewise, Sraboni and Quisumbing (2018b) found evidence of WEAI determinants, whereas women's group membership (leadership domain) and decision-making (resource domain) significantly correlate with adult male BMI. According to this study, empowerment in which women group membership (leadership domain), women's decisions on credit (resource domain), and women's ownership of assets (resource domain) explain diet diversity improvement. Further findings in terms of better iron deficiency through the pathway of women's empowerment measured by WEAI offer substantive theoretical knowledge in the context of explicit measurement of iron status from the case of India (Gupta et al., 2019a). Although there are studies identifying putative domains of empowerment in agriculture, methodological approaches to measure and analyze women's empowerment have been facing major challenges in its contextual nature (Malhotra and Ruth Schuler, 2005). In the case of WEAI as a reliable index, indexation should consider regional differences (Gupta et al., 2019b; O'Hara and Clement, 2018). Considering the relationship between empowerment domains and related nutritional outcomes, there is not always an improvement in nutritional outcomes (Malapit et al., 2015; Zereyesus et al., 2017), which incentivizes more studies covering culture- and context-specific diversities for interventions in maternal and child nutrition (Malapit and Quisumbing, 2015). Findings with the WEAI methodology indicate that women are three times more disempowered compared to men in Tajikistan (Malapit et al., 2014a); therefore, further studies are required to unfold nutritional outcomes and food security.

3. Methodology

3.1. Country Context and Data

Tajikistan's GDP per capita level is still significantly below in real terms, which means that almost half of the population lives under the absolute poverty line (FEEDBACK, 2014a). Nutritional problems in Tajikistan remain one of the severe problems locking people into health problems (World Bank, 2018). Current economic difficulties have driven the rural population to the brink of food insecurity (ADB, 2019), where malnutrition is still one of severe problems (WFP, 2020). Feed for the Future Feedback covers regions targeted by Feed the Future interventions known as Feed the Future Zones of Influence (ZOI) (FEEDBACK, 2014a). Feed the Future Tajikistan data is a population-based survey (PBS) collected with the initiation of Feed the Future by USAID. The period for data collection was from December 23, 2012, to January 23, 2013, in the Khatlon region. There are 2000 households from 12 of 24 districts in the region (see, Map-1). Khatlon is one of the poorest regions in Tajikistan (FEEDBACK, 2014a), where most districts experience a continuum of food insecurity (WFP, 2017).



Map-1: Feed the Future Intervention Areas within the ZOI (There are 12 districts in the Khatlon province: Qubodiyon, Qumsangir, Vakhsh, Nosiri Khusrav, Jilikul, Bokhtar, Khuroson, Jomi, Yovon, J. Rumi, Sharituz, and Sarband

Source: USAID, 2014

3.2. Empirical Specifications and Variables

The latent Class (LC) study, a mixture model, defines unobserved categorical variables by dividing the population into mutually exclusive latent classes (Hagenaars and McCutcheon, 2002). Looking at LC assumptions, values of observed variables within latent classes are independent, known as "local independence" or "uncorrelated uniqueness" assumptions in factor analysis (Tein et al., 2013). Accordingly, a latent variable approach helps us manage response patterns around the empowerment dimension to such an extent that we can discern related meaningful and scientifically interesting classes.

In our paper, the topology of all three dimensions is constructed using either latent class analysis (LCA) or latent profile analysis (LPA). In this case, empowerment dimensions represented through latent categorical variables are used to investigate the association with predictor variables (Vermunt, 2017). The density function of LCA model for observed x variable is given as (Collier and Leite, 2017):

$$f(x) = \pi_1 f_1(x, \theta_1) + \ldots + \pi_K f_K(x, \theta_K) \quad (1)$$

where $f(x)$ is the multivariate probability density function for observed x variable. The proportion of respondents in Class K is defined by π_K. As the difference between LCA and LPA is explained by weather indicators are treated as categorical and continuous in turn (Collins and Lanza, 2009), the density function of LPA can be expressed as (Collier and Leite, 2017):

$$f(x_i|\theta) = \sum_1^K \pi_K f_K(x_i|\theta_K) \quad (2)$$

where $f_K(x_i|\theta_K)$ is a class-specific density function for class K.

In the second step, we apply the posterior distribution of latent classes as given below (Collier and Leite, 2017):

$$p(\eta|x) = \frac{p(x|\eta)\ p(\eta)}{\sum_{\eta=1}^K p(x|\eta)\ p(\eta)} \quad (3)$$

In the last stage, we regress the estimated class membership on the predictor auxiliary variables by using a multinomial logistic regression model (Vermunt, 2017).

$$\mathrm{P}(\eta = \mathrm{k}|Z_i) = \frac{\exp(\gamma_{0k} + \sum_{q=1}^Q \gamma_{qk} Z_{iq}}{\sum_{s=1}^K \exp(\gamma_{0s} + \sum_{q=1}^Q \gamma_{qs} Z_{iq})} \quad (4)$$

where η is a class membership of the estimation and Z_{iq} is one of Q covariates. A covariate vector for individual i is defined by Z_i. The parameters of interests are the γ_{qk}, for $0 \leq q \leq Q$.

Key Dependent Variables for Women Anthropometry and Nutrition Status:

A) *Dietary diversity for women* is used to define micronutrient deficiencies and their relationship with the empowerment. Diet diversity indicator applied as a tool to determine household food access in both middle-income and poor counties (Hoddinott and Yohannes, 2015) is measured through 9 types of products consumed within 24 hours (Kennedy et al., 2011). Accordingly, this indicator in our paper represents types of food group consumption in the previous day for the women who are reproductive ages between 15-49 years old. In the calculation, there are the following types of food groups included: (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (40 organ meat; (5) eggs; (6) flesh food and small animal protein; (7) vitamin A-rich dark green leafy vegetables; (8) other vitamin A-rich vegetables and fruits; and (9) other fruits and vegetables.

B) *Body Mass Index (BMI)* is one key variable showing women's nutritional status. BMI represents the ratio of weight to height to classify underweight, overweight, and obese levels (WHO, 2000). In this paper, BMI variable characterizes non-pregnant women of reproductive age between 15 and 49 years old.

Key Dependent Variable for Household Hunger:

C) *The Household Hunger Scale (HHS)* indicates the household hunger scale to understand whether the household is with moderate or severe hunger (Ballard et al., 2016). Accordingly, HHS is appropriate for measuring the food access of the dimension.

Key Dependent Variables for Child Anthropometry and Nutrition Status:

D) *Exclusive breast-feeding for children (0-5 months)* is our first indicator representing the nutritional status of children. The indicator shows the proportion of the infant who received breast milk (including milk expressed or from a wet nurse) without any other food or liquid, including water during the previous day (WHO, 2010).

E) *Dietary diversity for children (6-13 months)* is used as one of the key measures for child nutritional status. This measurement includes seven food groups consumed in the last 24 hours (1) grains, roots, and tubers; (2) legumes and nuts; (3) dairy products; (5) eggs; (6) vitamin A-rich fruits and vegetables; and (7) other fruits and vegetables (WHO, 2010).

F) *Child Anthropometric Variables* are related to key dependent outcomes for anthropometric z-scores for children under five. The first important empirical specification is based on outcome variables known as HAZ (height - for - age Z - score), WAZ (weight - for - age Z - score), and WHZ (weight - for - height Z - score). According to the scheme for the degree of malnutrition, there are four classifications known as low, medium, high, and very high levels of malnutrition (WHO, 1995).

Key Independent Variables:

Based on the level of contribution of each indicator to women's disempowerment, we define three models in order to look at possible relationships. In this case, we apply LCA or LPA models to divide the sample for the three selected most disempowering domains into mutually exclusive latent classes or profiles. Therefore, the created categorical latent variable represents the extent of empowerment in agriculture in its corresponding domain. Findings from the case of Tajikistan has already defined that group membership, autonomy in production, and access to and decisions on credit are the most contributing indicators to women's disempowerment (Malapit et al., 2014a). Accordingly, our focus is given to the most disempowerment contributing variables, which are the most disempowering indicators.

Mode-1: (Resource domain, Purchase, sale, or transfer of assets)

Although access to and decisions on credit represents the domain contributing the most to women's disempowerment, the point where women are particularly credit constrained is not relatively clear due to missing liquidity information (Sraboni et al., 2014a; Sraboni and Quisumbing, 2018b; Sraboni et al., 2014b). Therefore, we mainly use another contributing factor in production: purchase, sale, or transfer of assets. Within this indicator, we create a categorical variable by focusing on the question *"Who contributes most to decisions regarding a new purchase of following item?"* (Alkire et al., 2013a). According to WEAI methodology, there are seven production capitals related to agricultural purposes. Taking seven items into the model, six productive capitals are converged in our latent classes. Specifically, we include (i) agriculture land (pieces/plot); (ii) large livestock (oxen and cattle); (iii) small livestock (goats, pigs, and sheep); (iv) chickens, ducks, turkeys, and pigeons; (v) farm equipment (non-mechanized); and (vi) farm equipment (mechanized). A response is measured by creating a dummy variable, indicating whether women took part in the process or with other household members to make a decision for a new purchase of production capital in agriculture. In this

case, we use LCA application to create a variable representing access to productive capital in the resource domain.

Mode-2: (Production domain, Autonomy in production)

Assuming its practical conformity to illustrate leadership and resource domains, scholars primarily classify the empowerment by focusing on the number of group memberships and decisions made, respectively (Malapit and Quisumbing, 2015; Sraboni et al., 2014a; Sraboni and Quisumbing, 2018b). To represent autonomy in production, we draw primarily on autonomy indicator measurement including whether the person is externally coerced or not (Alkire et al., 2013a). Based on WEAI methodology, the coercion representing the motivation is defined by the statement, *"My actions (aspect) are partly because I will get in trouble with someone if I act differently".* This statement is applied for options, where the motivation for decision making in the production includes (i) getting inputs for agricultural production; (ii) the types of crops to grow for agricultural production; (iii) taking crops to the market (or not); and (iv) livestock rising. The statement has been measured with a Likert scale, representing 1 as never true and 4 as always true for motivation options. Therefore, we apply LPA to represent autonomy in production in the production domain.

Mode-3: (Leadership domain, Group membership indicator)

In this paper, our latent classification is based on creating a categorical variable for group membership within 11 types of groups available for women (Alkire et al., 2013a) out of which only six groups are included due to non-convergence. In this response, we include the group membership by the question *"Are you an active member of this group?"* (1) agriculture, livestock, fisheries producers' group including marketing group as well, (2) forest users' group, (3) credit or microfinance groups, (4) mutual help or insurance group (including burial societies), (5) civic groups (improving community) or charitable group (helping others), and (6) local government group. As the measurement for group membership is determined by dummy response, we apply LCA to create a group membership categorical variable.

3.3 Model selection

An unconditional model is used to compare with other classes until the model is specified as the best fit by applying certain criteria. The optimal number of classes is determined by using Akaike's information criterion(AIC) (Akaike, 1987), Bayesian information criterion (BIC) (Schwarz, 1978), and entropy criterion (Celeux and Soromenho, 1996). Table-2 shows model fit criteria based on different scores for choosing the best latent class representing selected

domains. Concerning resource and leadership domains, we have two-class models as the best fit (the third-class model does not converge for group membership). As for autonomy in production, coercion is the best fit with a three-class solution (the fourth class does not converge).

Model-1: Resource Domain - Purchase of Assets						
Models	**Obs**	**LL(model)**	**Npar**	**AIC**	**BIC**	**Entropy**
Model-1	1,623	-2969.035	6	5950.069	5982.421	N.A
Model-2	**1,623**	**-2490.757**	**13**	**5007.513**	**5077.610**	**68.91**
Model-3	1,623	-2478.859	20	4997.718	5105.559	64.26
Model-2: Production Domain - Autonomy in Production						
Model-1	1,563	-6985.121	8	13986.24	14029.08	N.A
Model-2	1,563	-5708.826	13	11443.65	11443.26	69.30
Model-3	**1,563**	**-5461.596**	**18**	**10959.19**	**11055.57**	**65.02**
Model-3: Leadership Domain - Group Membership						
Model-1	1,077	-826.7253	6	1665.451	1695.342	N.A
Model-2	**1,077**	**-790.7982**	**13**	**1607.596**	**1672.362**	**60.11**

Table-2: Model fit criteria for LCA and LPA

As for the decision making for a new purchase over productive capital in agricultural activities in Class 1, there is a high-risk proneness contributing to disempowerment (Figure-1). In other words, women in this class suffer from making self or joint decisions in new purchases; therefore, this latent class is also labelled as “Low Autonomy”, and it represented 54.48% of class belonging. On the other hand, women with self or joint decision making authorities are inherent in Class 2, which is “High Autonomy”. This group accounts for the remaining 45.52% of the sample.

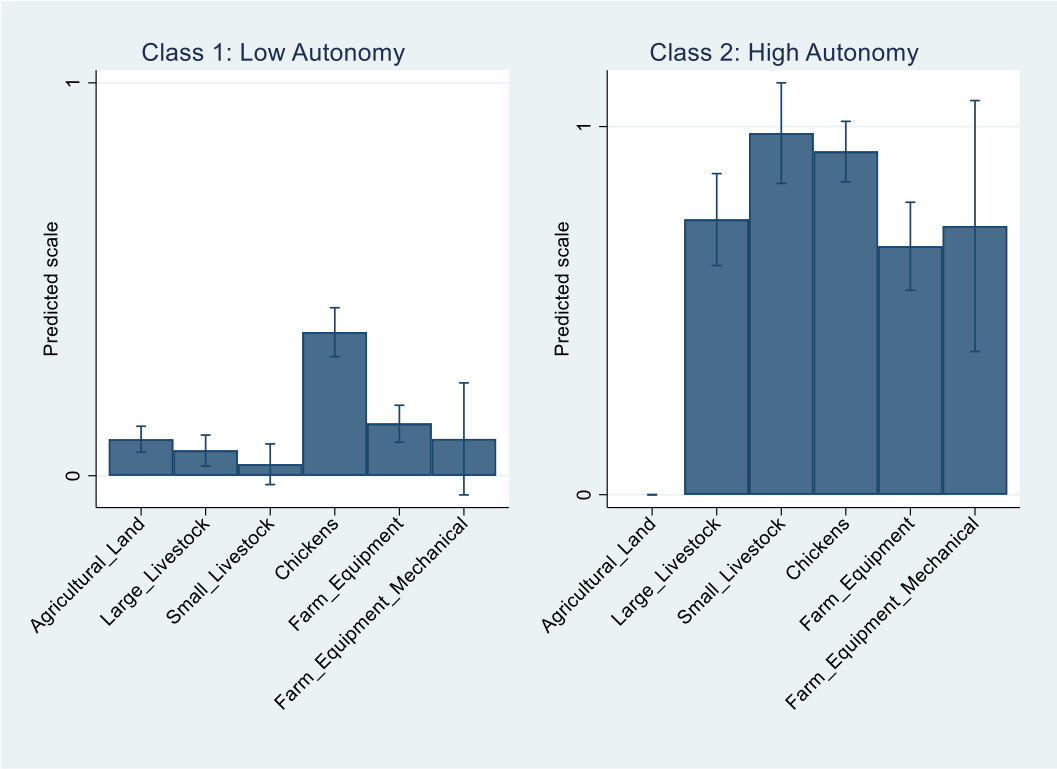


Figure-1: LCA for Purchase of Assets

Looking at autonomy in production (Figure-2), Profile 1 is externally coerced, indicating women are limited in terms of own actions for decision making in all four life aspects. Therefore, this group, representing 15.49%, is labelled as "Coerced Motivation". Our Class-2, which is "Not-Coerced Motivation", shows its highest motivation, accounting for 43.92%. The last group is referred to "Medium Coerced Motivation" because women are close to coerced motivation for their decision making (Figure-2) and this group makes up remaining 40.59%.

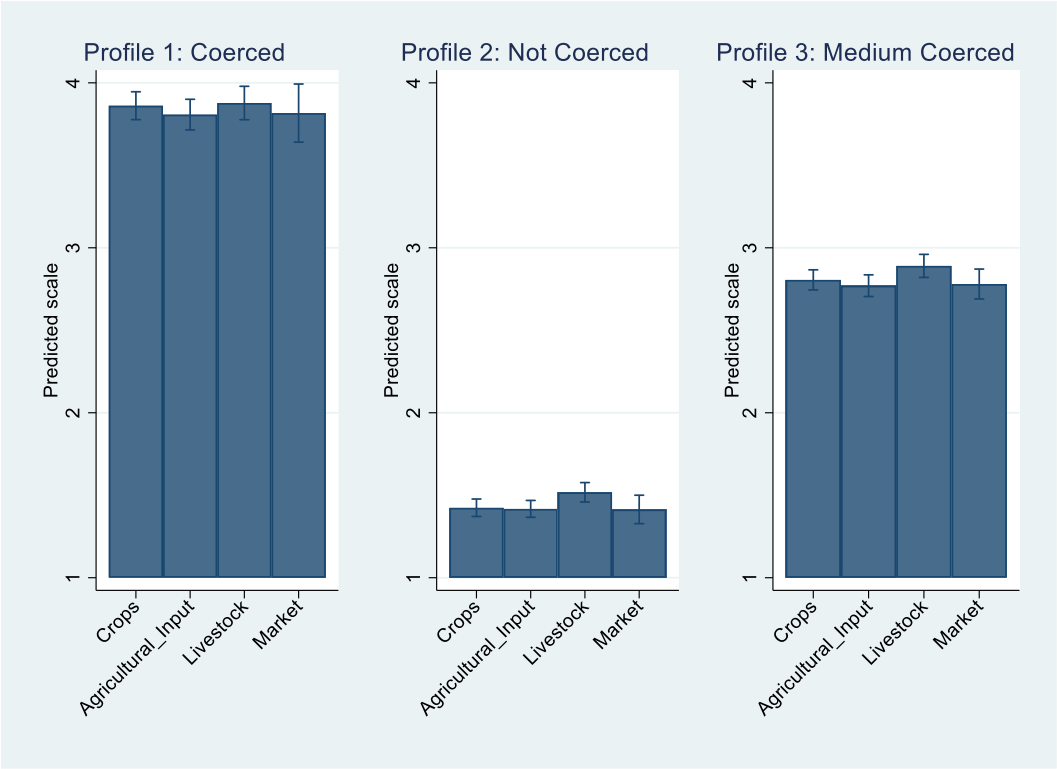


Figure-2: LPA for Autonomy in Production

Our next important indicator is ascertained through group membership. It is very explicit that the group membership is extremely low among women in the first class (Figure-3). Therefore, we name this group "Not Active Members"; the predicted latent class probability makes up 71.11% of total sample. Compared to Class 1, the following Class 2 shows its relatively higher predicted scales to be a member of certain groups by representing the remaining 28.89% of sample; therefore, we label this class under the name of "Active Members".

Figure-3: LCA for Group Membership

4. Results

4.1. Descriptive Statistics

Summary statistics, including anthropometric variables together with individual and household characteristics, are provided in Table-3. As for women's anthropometric measures, the diet diversity of women is close to 5 out of 9. While women's BMI represents 23.96, the percentage of underweight women makes up only 5%. Although the mean of households is characterized by little or no-hunger, 13% still experiences either moderate or severe hunger. Looking at child anthropometric measures, exclusive breast-feeding represents only 37%. Poor diet diversity of children is characteristic of infant and young child feeding practice for 6-23 month children. Meantime, a stunting is found relatively problematic compared to underweight and wasting.

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Women's anthropometric measures					
Number of food groups consumed (out of 9)	3195	4.43	2.06	0	9
Body Mass Index (BMI)	2929	23.96	4.48	14.64	49.12
Underweight BMI	2929	0.05	0.23	0	1
Household Hunger					
Household hunger scale	1987	0.53	1.055	0	6
Moderate or severe household hunger	1978	0.13	0.34	0	1
Child nutritional outcomes					
Exclusive breast-feeding	180	0.37	0.48	0	1
Diet diversity (7 food groups)	625	2.41	1.75	0	7
Underweight (WAZ< -2 SD)	1822	0.09	0.29	0	1
Stunting (HAZ< -2 SD)	1822	0.30	0.45	0	1
Wasting (WHZ< -2 SD)	1822	0.07	0.25	0	1
Diet diversity (7 food groups)	625	2.41	1.75	0	7
Women characteristics					
Age	3214	28.23	9.62	15	49
Literacy	3174	0.88	0.31	0	1
Education Level	2,963	0.01	0.13	0	1
Household characteristics					
Household size	1977	7.39	3.49	1	26
Household weight	1999	115.52	38.55	86.511	294.6

Rural	1999	0.90	0.28	0	1
Working abroad	1998	0.41	0.49	0	1
Daily total household expenditures with holiday deflator (in local currency)	1965	72.62	52.72	6.21	549.68
Daily per capita consumption (in local currency)	1965	10.73	6.74	1.74	79.62

Table-3 Summary Statistics

According to women's characteristics, the average age of women is 28.23 years old. The majority of women are literate, while the average education level is basic. With respect to household level characteristics, there are an average of more than 7 people per household. Most households are from rural areas, representing 90% of the sample. People who work abroad make up 41% of the sample. The average household expenditure is 72.62 TJS, where 10.73 TJS is daily per capita consumption.

4.2 Class Compare

With respect to the resource domain illustrated with Table-5, class comparing findings for anthropometric measures are not statistically significant. However, households with higher *women's autonomy in decision for purchasing productive capitals* are pronounced with relatively increased household hunger scale ("Low Autonomy": 0.43 and "High Autonomy": 0.65). At the same time, the cases of moderate or severe hunger are relatively few in "Low Autonomy" class, with 10.18% as opposed to 17.04% in "High Autonomy" class. As for the child's nutritional outcomes, the dietary diversity score is statistically significant and higher in "High Autonomy" class ("Low Autonomy": 2.11 and "High Autonomy": 2.62).

	Low Autonomy	**High Autonomy**	**p-value**
Women's anthropometric measures			
Diet Diversity	4.11 (47.53)	4.20 (52.47)	0.324
BMI	26.00 (46.49)	26.27 (53.51)	0.820
Underweight			0.508
No	334 (97.09)	381 (96.21)	
Yes	10 (2.91)	15 (3.79)	
Household Hunger			
Household Hunger Scale	0.43 (48.22)	0.65 (51.78)	0.000
Moderate or Severe Hunger			0.000
No	741 (89.82)	735 (82.96)	
Yes	84 (10.18)	151 (17.04)	
Child nutritional outcomes			
Breast-feeding			0.638
No	39 (61.90)	37 (57.81)	
Yes	24 (38.10)	27 (42.19)	
Diet Diversity	2.11 (54.81)	2.62 (45.19)	0.003
Underweight (WAZ < -2 SD)			0.397
No	598 (91.30)	497 (89.87)	
Yes	57 (8.70)	56 (10.13)	
Stunting (HAZ < -2 SD)			0.344
No	463 (70.69)	377 (68.17)	
Yes	192 (29.31)	176 (31.83)	
Wasting (WHZ < -2 SD)			0.629
No	619 (94.50)	519 (93.85)	
Yes	36 (5.50)	34 (6.15)	

Table-4: Nutritional Outcomes and Food Security by LCA in Purchase of Assets

Looking at class differences among respondents for the external coercion in Table-5, the measures for women's nutritional outcomes are not statistically significant. At the same time, both the household hunger scale and the cases of moderate or severe hunger are statistically significant. Precisely, the "Not - Coerced" class is apparent to have better conditions in terms of hunger scale (Coerced Motivation: 0.67; Medium Coerced Motivation: 0.61; and Not - Coerced Motivation: 0.42) with few moderate or severe hunger cases (Coerced Motivation: 16.67%; Medium Coerced Motivation: 15.25%; and Not - Coerced Motivation: 10.65%). Child nutritional outcomes are found not statistically significant.

	Coerced	**Not - Coerced**	**Medium Coerced**	
Women's anthropometric measures				
Diet Diversity	3.90 (13.41)	4.19 (39.14)	4.18 (47.45)	0.288
BMI	26.90 (13.37)	26.07 (38.58)	25.96 (48.05)	0.252
Underweight				0.715
No	94 (97.92)	268 (96.75)	332 (96.23)	
Yes	2 (2.08)	9 (3.25)	13 (3.77)	
Household Hunger				
Household Hunger Scale	0.67 (13.44)	0.42 (40.92)	0.61 (45.64)	0.017
Moderate or Severe Hunger				0.014
No	185 (83.33)	604 (89.35)	639 (84.75)	
Yes	37 (16.67)	72 (10.65)	115 (15.25)	
Child nutritional outcomes				
Breast-feeding				0.343
No	108 (96.43)	529 (94.46)	457 (93.08)	
Yes	4 (3.57)	31 (5.54)	34 (6.92)	
Diet Diversity	2.8 (10.49)	2.25 (43.99)	2.31 (45.52)	0.144
Underweight (WAZ < -2 SD)				0.615
No	100 (89.29)	511 (91.25)	440 (89.61)	
Yes	12 (10.71)	49 (8.75)	51 (10.39)	
Stunting (HAZ < -2 SD)				0.895
No	79 (70.54)	392 (70.00)	338 (68.84)	
Yes	33 (29.46)	168 (30.00)	153 (31.16)	
Wasting (WHZ < -2 SD)				0.343
No	108 (96.430	529 (94.46)	457 (93.08)	

Yes	4 (3.57)	31 (5.54)	34 (6.92)

Table-5: Nutritional Outcomes and Food Security by LPA in Autonomy in Production

Table-6 provides class comparisons for group membership and nutritional outcomes together with food security. Accordingly, the active membership group has relatively higher mean score for women's diet diversity ("Not-Active Member": 3.94 and "Active Member": 4.34). As for the association between latent class and other indicators such as BMI or underweight, it is not statistically significant. Concerning the household hunger scale, the class "Active Member" is characterized by a better household hunger scale compared to another class ("Not-Active Member": 0.63 and "Active Member": 0.47), thereby experiencing few cases in terms of moderate or severe hunger in "Active Member" class with 11.45% cases. As for the nutritional outcomes of children, the percentage of exclusive breast-feeding is relatively higher in the "Active Member" group at 50.94% compared to the situation in "Not-Active Member" class. Moreover, a relatively higher mean consumption of food diversity among children is observed in "Active Membership" class making up 2.50. In the meantime, the prevalence of stunting is significantly less in the class, where there is an active role of women's membership ("Not-Active Member": 33.52% and "Active Member": 27.97%). Other indicators for child nutritional outcomes are statistically insignificant.

	Not Active Member	**Active Member**	**p-value**
Women's anthropometric measures			
Diet Diversity	3.94 (47.79)	4.34 (52.21)	0.001
BMI	26.35 (47.98)	25.98 (52.02)	0.475
Underweight			0.223
No	347 (97.47)	370 (95.85)	
Yes	9 (2.53)	16 (4.15)	
Household Hunger			
Household Hunger Scale	0.63 (46.53)	0.47 (53.47)	0.003
Moderate or Severe Hunger			0.003
No	667 (85.58)	812 (88.55)	
Yes	131 (16.42)	105 (11.45)	
Child nutritional outcomes			
Breast-feeding			0.036
No	50 (67.57)	26 (49.06)	
Yes	24 (32.43)	27 (50.94)	
Food Group	2.14 (45.19)	2.50 (54.81)	0.073
Underweight (WAZ < -2 SD)			0.545
No	492 (90.11)	606 (91.13)	

Yes	54 (9.89)	59 (8.87)	
Stunting (HAZ < -2 SD)			0.037
No	363 (66.48)	479 (72.03)	
Yes	183 (33.52)	186 (27.97)	
Wasting (WHZ < -2 SD)			0.395
No	511 (93.59)	630 (94.74)	
Yes	35 (6.41)	35 (5.26)	

Table-6: Nutritional Outcomes and Food Security by LCA in Group Membership

4.3 Nutritional Outcomes and Food Security with Latent Classes and Profiles

According to the resource domain, there is no significant relationship between women's anthropometric measures and class membership. However, the overall situation of household hunger is not improved in households with higher autonomy decision making. Precisely, there is a higher household hunger scale (OR 1.19, 95% CI 1.07-1.32, P<0.01) and moderate or severe hunger cases (OR 1.65, 95% CI 1.21-2.24, P<0.01) in the "High Autonomy" class compared to those in "Low Autonomy" reference group. However, children in the "High Autonomy Decision" class have higher odds of diet diversity (OR 1.23, 95% CI 1.08-1.40, P<0.01) and minimum meal frequency (OR 1.96, 95% CI 0.89-4.32, P<0.10).

	Class-2: High-Autonomy		
	PR	95% CI	p-value
Women's anthropometric measures			
Diet diversity (n=766)	1.04	0.96 – 1.12	0.283
BMI (n=738)	1.01	0.98 – 1.04	0.458
Underweight (n=738)	1.42	0.60 – 3.38	0.418
Household Hunger			
Household Hunger Scale (n=1,702)	1.19	1.07 – 1.32	0.001
Moderate or Severe Hunger (n=1,702)	1.65	1.21 – 2.24	0.001
Child nutritional outcomes			
Breast - feeding (n=127)	1.37	0.60 – 3.12	0.441
Diet diversity (n=405)	1.23	1.08 – 1.40	0.002
Underweight (WAZ < -2 SD) (n=1,207)	1.26	0.84 – 1.91	0.255
Stunting (HAZ < -2 SD) (n=1,207)	1.13	0.87 – 1.47	0.333
Wasting (WHZ < -2 SD) (n=1,207)	1.19	0.71 – 1.98	0.500

Table-10: Association between Nutritional Outcomes and Food Security with Class Membership in Purchase of Assets

Taking “Coerced Motivation” as a reference in the production domain, “Not-Coerced Motivation” class is negatively and significantly associated with household hunger scale (OR 0.84, 95% CI 0.72-0.97, P<0.05), indicating the improved situation in household food security. Taken together with our findings on child nutritional outcomes, decreased dietary quality is observed in both “Medium Coerced Motivation” (OR 0.80, 95% CI 0.65-0.99, P<0.05) and “Not-Coerced Motivation” classes (OR 0.78, 95% CI 0.63-0.96, P<0.05).

	Profile-2: Not-Coerced Motivation			Profile-3: Medium-Coerced Motivation		
	PR	95% CI	p-value	PR	95% CI	p-value
Women's anthropometric measures						
Diet diversity (n=744)	1.05	0.93 – 1.20	0.361	1.06	0.94 – 1.20	0.309
BMI (n=716)	0.96	0.92 – 1.00	0.120	0.96	0.92 – 1.01	0.138
Underweight (n=716)	1.68	0.35 – 8.07	0.514	1.86	0.40 – 8.64	0.425
Household Hunger						
Household Hunger Scale (n=1,644)	0.84	0.72 – 0.97	0.023	0.98	0.86 – 1.13	0.852
Moderate or Severe Hunger (n=1,644)	0.72	0.46 – 1.13	0.162	0.98	0.64 – 1.50	0.949
Child nutritional outcomes						
Breast - feeding (n=121)	0.55	0.15 – 2.05	0.377	0.58	0.15 – 2.21	0.428

Diet diversity (n=391)	0.78	0.63 – 0.96	0.023	0.80	0.65 – 0.99	0.045
Underweight (WAZ < -2 SD) (n=1,162)	0.77	0.38 – 1.55	0.466	0.96	0.48 – 1.90	0.916
Stunting (HAZ < -2 SD) (n=1,162)	1.14	0.71 – 1.82	0.576	1.13	0.71 – 1.81	0.579
Wasting (WHZ < -2 SD) (n=1,162)	1.44	0.47 – 4.35	0.517	2.00	0.67 – 5.90	0.208

Table-9: Association between Nutritional Outcomes and Food Security with Class Membership in Autonomy in Production

Using "Non-Active Membership" as the reference class, women's diet diversity is characterized as positively associated with higher empowerment attributed to the group of "Active Membership" (OR 1.10, 95% CI 1.02-1.186, P<0.05). Moreover, we find a statistically significant relationship with better HHS in the class represented by "Active Membership" (OR 0.87, 95% CI 0.79-0.95, P<0.01). Correspondingly, the situation identified by either moderate or severe household hunger is also improved in the "Active Membership" class (OR 0.65, 95% CI 0.49-0.87, P<0.01). Based on findings for children's nutritional outcomes, women's role under "Active Membership" is significantly associated with improved diet diversity score based on seven groups compared to the situation in the reference Class (OR 1.16, 95% CI 1.03-1.32, P<0.05). Similarly, this class is also associated with higher HAZ (OR 1.08, 95% CI 1.02-1.15, P<0.05) or decreasing levels of the prevalence of stunted children (OR 0.73, 95% CI 0.57-0.94, P<0.05).

	Class-2: Active Member		
	PR	95% CI	p-value
Women's anthropometric measures			
Diet diversity (n=768)	1.10	1.02 – 1.18	0.013
BMI (n=740)	0.98	0.95 – 1.01	0.307
Underweight (n=740)	1.63	0.70 – 3.79	0.251
Household Hunger			
Household Hunger Scale (1,706)	0.87	0.79 – 0.95	0.004
Moderate or Severe Hunger (1,706)	0.65	0.49 – 0.87	0.004
Child nutritional outcomes			
Breast - feeding (n=127)	2.06	0.87 – 4.90	0.098
Diet diversity (n=405)	1.16	1.03 – 1.32	0.014
Underweight (WAZ < -2 SD) (n=1,210)	0.88	0.59 – 1.31	0.543
Stunting (HAZ < -2 SD) (n=1,2010)	0.73	0.57 – 0.94	0.018
Wasting (WHZ < -2 SD) (n=1,210)	0.88	0.54 – 1.45	0.644

Table-11: Association between Nutritional Outcomes and Food Security with Class Membership in Group Membership

5. Discussion

This study investigates the relationship between women's empowerment dimensions and nutritional outcomes reflected on different food security measures together with anthropometric indicators. Although not all WEAI indicators are consistently associated with nutritional or anthropometric outcomes, findings generally indicate the significance of empowerment for improving nutritional outcomes and household food security conditions. To our knowledge, the present study represents the first attempt to examine the role of women through latent class techniques. Our outcomes represent the most contributing factors through latent classes in which some classes are found to be amenable in order to balance nutritional outcomes or food security. As we find capturing associations between empowerment domains and related anthropometric measures, findings play a significant role in promoting nutritional sensitive agriculture. Generally, our findings indicate that women in Tajikistan lack adequate empowerment in agriculture, which is similar to findings from other regions (Ragsdale et al., 2018). By decomposing the WEAI into dimensions, different domains are identified as promising areas for both child and maternal nutritional improvements, albeit without consistency. This difference can be explained by other country-specific factors, indicating the nature of women's empowerment though WEAI framework varies across countries or regions (Akter et al., 2017). In the meantime, different domains are expected to be associated with nutritional outcomes differently (Malapit and Quisumbing, 2015). Taking the comments of other determinants defining the level of empowerment (O'Hara and Clement, 2018), there should be further actions to formulate policy strategies focusing on regional differences (Akter et al., 2017).

Looking at the outcomes with each class membership represented through the use of LCA and LPA, women's empowerment in the production domain is pronounced in improving household hunger score, indicating better food security for those households classified as "Not-Coerced Motivation". However, families explained that higher autonomy in production predisposes children to experience decreased dietary quality. This inverse relationship between empowerment and dietary diversity can be explained by the fact that women's engagement in agricultural may deteriorate the possibility to pay more attention on cooking or eating meals frequently (Komatsu et al., 2018). In this circumstance, to address the growth problems of children, it is proposed enhance a nutrition-sensitive approach through women's empowerment and women's engagements (Bhutta et al., 2013), which gives us a message about the significance of empowerment through nutrition-sensitive approach. Therefore, we suggest women's empowerment may not be enough to deal with child anthropometric outcomes unless

their roles are nutritionally sensitive. We should be cognizant of the fact that "High Autonomy" represents the resource domain and does not guarantee improving the situation for household hunger. This result might be due to respondent's perception of the meaning of empowerment in their decision-making towards the agricultural production (O'Hara and Clement, 2018). Although there is no better outcome in household hunger, diet diversity of children is likely to improve under the household, where there is higher autonomy of women towards the decision on resources. Despite finding this positive association, it is crucially important to look at the sociocultural environment in which women process nutrition or health related information (Lovell, 2016) and women's priority on nutritional practices for child's health (Lamstein, 2017). Moreover, we find that women's empowerment through a group membership makes inroads into better food security reflected on woman and child anthropometric measures and a household hunger score. There are many similar findings highlighting the significance of group membership in WEAI to improve diet diversity (Holland and Rammohan, 2019; Malapit et al., 2015; Sraboni et al., 2014a). Under our findings, the group membership representing the leadership domain is one of the most promising areas for policy intervention. Accordingly, there is a strong accentuation on the importance of the group membership constraint of WEAI as a result of which this domain is found one of the most top contributing factors to women's disempowerment (Malapit et al., 2014b). Our result in this paper suggests that women's role defined by "Active Membership" is associated with better diet diversity, decreased number of stunted children and improved household hunger.

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