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Abiotic, Biotic and Social-economic Factor Effecting Livestock Production in Rural Cambodia

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Abstract High-level development of policy, official government policy and policy-based evidence are principally gotten from the decision of farmers, producers, and other communities. To understand the farmers' decision better is to understand factors affecting their production, this paper aimed to identify the abiotic, biotic and socio-economic factors affecting livestock production in rural Cambodia. 204 rural households were interviewed. The result identified two major biotic factors affecting livestock production – diseases and parasites while the major factors on abiotic include heat stress and drought; and the top three social factors affecting their livestock production are low capital, poor breed and access to veterinary services. Using biplot analysis, the study reveals that farmers with large number of livestock consider most of the constraints minimal but put more emphasis on market information as their major constraints. The outcome of this research is specially suggested the Government to invest more the research and strengthening the livestock subsector.

Keywords: *livestock, biotic factors, abiotic factors, socioeconomic factors, biplot analysis, cambodia*

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1. Introduction

The perception of small-scale livestock farmers as recently been an interested to many scholars [1,2,3,4,5,6] to understand the demographic and socioeconomic factors that influence decision-making and the translation of intentions into sustained changes in farmers' behavior, is observed as an increasingly useful discipline in policy making, implementing and monitoring strategies to improve the productivities. Understanding farmers' behavior can easily assist in defining the role of policies and the level of knowledge as effective factors on the transition of livestock and agriculture sector. Wolf [7] mention that human perception is shapely designed by differing intellectual components due to socioeconomic and cultural variations that promote people to varying attitudes, values and passions. Therefore, livestock farmers are influenced by psychological and socioeconomic dissimilarities and formulated based on the lengthy experiences of multiple issues.

Livestock are recognized as domesticated animals reared in the agricultural setting to produce commodities: food, fiber and labor. In Cambodia, it plays extremely imperative function for the livelihood of rural residents. Livestock farming is assumed as one of the major sources of income and employing labor force (especially for cattle), provides organic fertilizer, and other advantages to both human and environment [8,9]. More so, some opportunities of livestock in Cambodia are the increasing domestic market and increasing demand from neighboring countries. In contrast, this subsector witnesses some constraints such as illiteracy, lack of capitals, seasonal cost of inputs, livestock high volatility price, effect on climate change (temperature), poor infrastructure, and import dependence of vet medicines, slow outbreak control and scarcity of labor [10,11]. The outbreak of diseases is considered the top constraints on the herd size of livestock caused by lack accessing to animal health services, fake or expired drugs, lack of knowledge about animal diseases and poorly organized vaccination services [12].

Due to these reasons, this paper aimed to further investigation the factors affecting livestock production farmer in rural Cambodia. The factors are categorized into three: biotic, abiotic and socioeconomic factors. An in-depth understanding of how the livestock farmers perceive these factors would be very useful for better adaptation strategic planning which will later improve planning scheme in agriculture other economic sectors. The

outcome of this research is specially suggested the Government to invest more the research and strengthening the livestock subsector.

2. Methods

The researches were carried out in Battambang province in the northwest of Cambodia. Cambodia is located in the southern portion of the Indochina Peninsula in Southeast Asia, dominated by tropical monsoons [13]. The region experiences two difference seasons: wet season (May to October) and dry season (November to April), more so, the country has Mekong River that cuts through the great plains, and the Tonle Sap surrounded by plateaus and cultivated hills [14]. The sites stand for varied farming systems and livelihoods with clear distinctions between the communities in terms of ecological characteristics. The majority of people are cropping farmer and engaged in cultivation of rice and other grains such as corn, and soybean which are one of the foremost feed components for livestock (cattle, pig and chicken) utilized by farmers.

2.2. Data Collection

The methods used to collect data in this paper were based on qualitative and quantitative method. About 204 household were interviewed in Battambang province of Cambodia under which 6 districts, 12 communes with 18 villages were covered using a structured questionnaire. Data were gathered to describe respondents' profile and various aspects of small-scale livestock production which the collection process started with:

Direct Observation was preliminarily used to better understand general situation and detail demography of the target area. Living condition and existing certainly livestock variety, this tool identified the agrarian and livestock farming system of the exactly ecological area. It also estimated the common disease syndrome level occurrence in each village.

Meetings and semi-structured interviews with the local authority (chief of district, commune and village) were conducted for gathering overall information, and links with officials of Animal Production Health (APH) at district level and Village Animal Health Worker (VAHW).

Survey-structured questionnaire: in-depth interviews or face to face interview with household farmers raising livestock covering various aspects such as household demography, livestock production, economics and management practices, production constraints, and trend and tendency of 3 livestock: Cattle, pig, and chicken.

2.3. Data Analysis

On the data analysis, EpiData software was used for coding and grouping of data collected into variables after which was later transferred to STATA software for further data generation, regression and analysis

2.4. Perception Pattern Analysis

The perception of the farmers on various abiotic, biotic and socio-economic aspects affecting their livestock production will be analyzed. Firstly, the statistical descriptive tools such as Frequency and Percentage of the variables will be depicted [15,16], multivariate analytical tools [17,18]. In this study, a multivariate (biplot) tool is used to analyze the perception. The Biplot technique here refers to a two–dimensional graph multivariate technique of simultaneously displaying observations (samples), and variables of a data matrix graphically; such information includes the inter-unit distances as well as variance and correlations of variables [19]. In the data matrix, the observations are positioned on rows and the relative variable positioned on columns. Graphically, an example is shown below in Figure 1. The marker symbols (points/dots) are displayed for observations and arrows are displayed for variables.

The above diagram shows 12 observations and 7 variables. The approximate variances of the variables are the length of the arrows while the angle between the arrows (cosine of the angles) approximates the correlation between the different variables. The distance between two dot/points (observations) is the Euclidean distance.

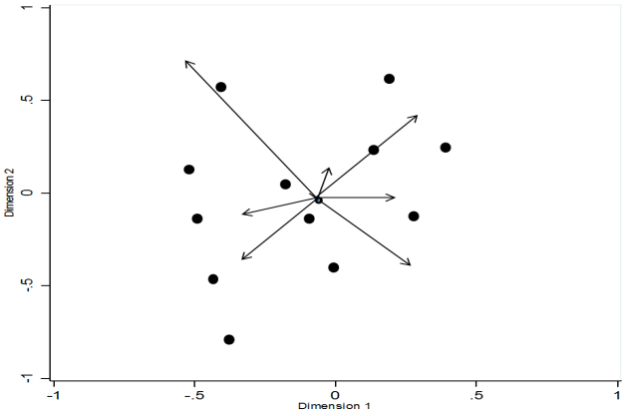


Figure 1. Biplot representing observations and variables

The Euclidean distance is defined as the square root of the sum of the squares of the differences between the observations. In an example of a two-dimension Euclidean geometry, the Euclidean distance between two observations say "$a=(a_x,a_x)$ & $b=(b_x,b_y)$" is defined by:

$$d(a,b) = \sqrt{\left((a_x-b_x)+(a_y-b_y)^2\right)}$$

The ratio of the units of the vertical axis and those on the horizontal axis is called the aspect ratio, and it's always equal to 1.

2.5. Biplot Mathematical Representation

Using Singular Value Decomposition (SVD), the information in matrix "X" for instance, is split into two; a portion related to the observations (i.e. the rows of X) and another portion related to variables (i.e. the column of X matrix).

$$X = Y \in Z' \quad (1)$$

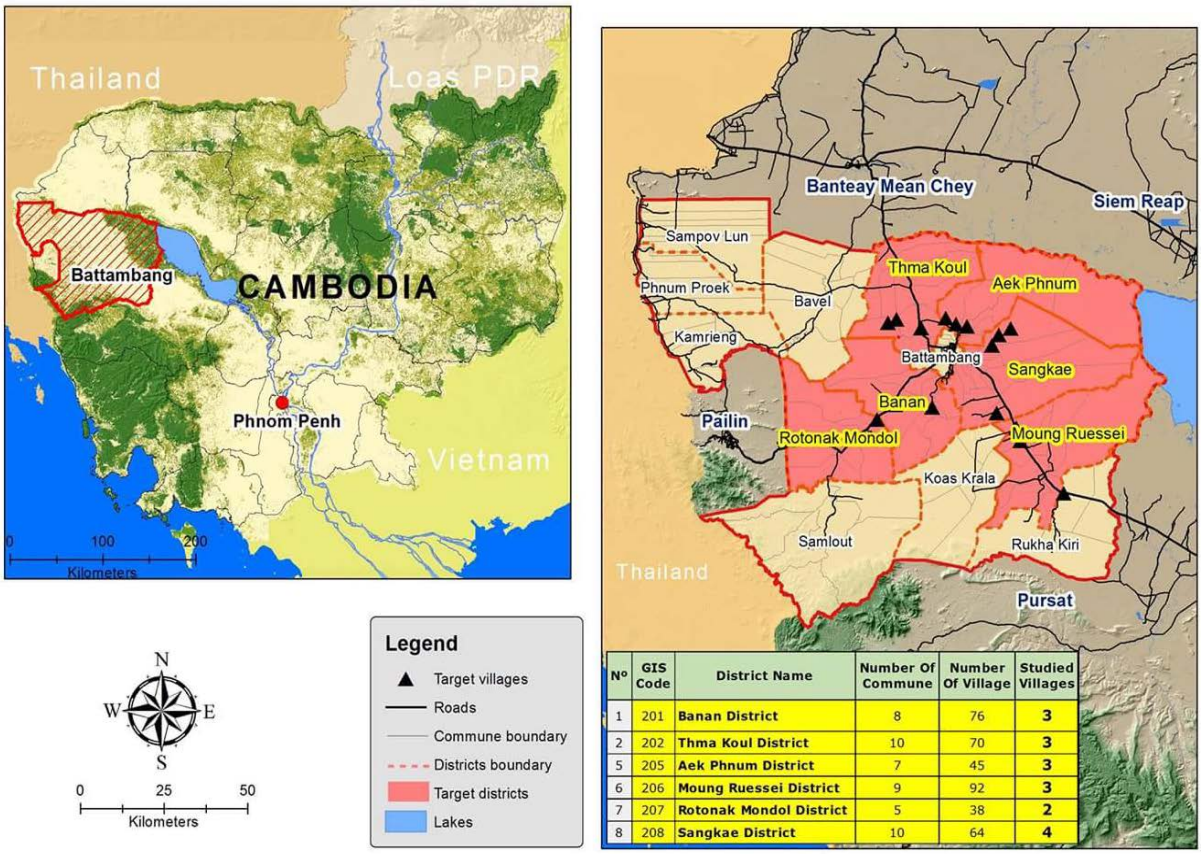
Where Y is $n \times k$, $\in$ & Z are $k \times k$. the$\in$ (diagonal data) is known as the eigenvalues. From the SVD, the eigenvalue becomes.

$$\in = \in^{\alpha} \in^{1-\alpha} \quad (2)$$

Therefore,

$$X = Y \in^{\alpha} \in^{1-\alpha} Z' \quad (3)$$

Where $Y \in^{\alpha}$ equal the coordinate for the observations and $\in^{1-\alpha} Z$ equals the coordinate of the variables. Let denote $Y \in^{\alpha}$ as "G" and $\in^{1-\alpha} Z'$ to be denoted as "H". The scalar Alfa (α) takes any value between zero and one (i.e. $? \leq \alpha \leq 1$). Regardless of the value, the equation remains $GH' = Y \in^{\alpha} \in^{1-\alpha} Z' = Y \in Z' = X$. However, as G is $n \times k$ and H is $k \times k$, all the coordinates have k dimensions. To indicate the quality of the approximation of the information provided by the biplot, the default axis titles (dimension 1 and 2 i.e. x and y axis respectively) indicate the amount of explained variances by the selected dimensions.



Nº	GIS Code	District Name	Number Of Commune	Number Of Village	Studied Villages
1	201	Banan District	8	76	3
2	202	Thma Koul District	10	70	3
5	205	Aek Phnum District	7	45	3
6	206	Moung Ruessei District	9	92	3
7	207	Rotonak Mondol District	5	38	2
8	208	Sangkae District	10	64	4

Figure 2. Map of Battambang showing the surveyed districts [22]

3. Results and Discussion

With emphasis on objectives of the study, farmer was required to rank (from 0 to 4) each of the classified constraints regarding to the degree of occurrence to their livestock productivities. Zero (0) equals no knowledge of the constraints; one (1) indicates that constraint "doesn't existing" two (2), constraint is "low", or insignificant to affecting farmer livestock production; three (3) and four (4) ranking constraints as "medium" and "high" respectively.

To evaluate the farmer livestock constraints, this study classified the constraints into three categories: biotic, abiotic and socioeconomic constraints. The biotic constraints are related or result of living organisms such as wild animals, parasites, diseases and plants, the abiotic constraints consist associated with physical rather than biological agents such as temperature and availability of water, and the finally the socio-economic constraints relating or concerned with of social and economic factors such as marketing system and socio amenities [15,20].

Biotic constraints: relating to the living organisms affecting livestock production, figure 3 below depicted the average ranking to each biotic factors constraint as perceived by farmer in rural Cambodia. The farmer considered diseases spreading and insect & parasite as the major constraints (on average ranking 2 and above) to livestock production. Meanwhile the point of effectiveness of theft is less (ranking 1.7) consideration as constraints to livestock production.

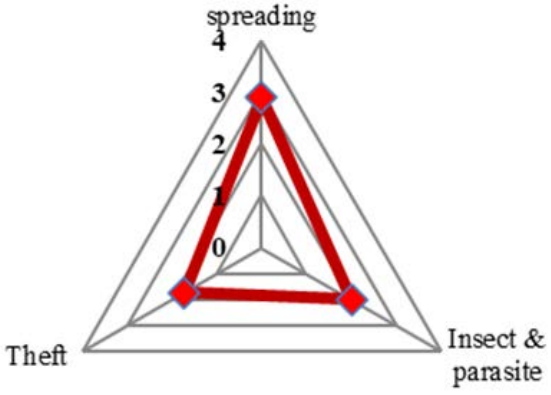


Figure 3. Biotic constraints

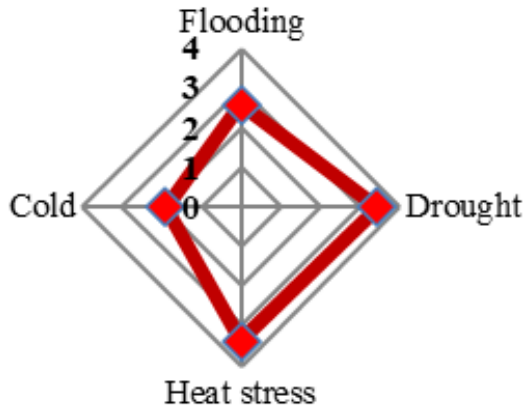


Figure 4. Abiotic constraints

Abiotic constraints: based on the environment include light, temperature, and atmospheric gases. This study summarized the abiotic constraints (Figure 4) majorly into cold, heat stress, drought and flood which affect the ecological of the field of livestock production. The farmers from the surveyed areas rated abiotic factors accord to the occurrence/rate and damages caused by flood, drought, heat stress and cold. The average perception of farmer toward livestock production constraints caused by abiotic factors, drought and heat stress (on average ranks above 3) are the major obstacle for livestock rearing. The least ranked constraint was cold temperature. Flood mostly affects smaller livestock production chicken causing cold or destruction of animal shelter.

Socioeconomic constraints: These constraints are related to accessing social and economic factors of livestock production input such as veterinary services, vaccines, market information, credit and fund availability, capital, social amenities, labor, transportation cost, mechanization, feed resource, Taxation, new breeds and land spaces for livestock rearing (see Figure 5).

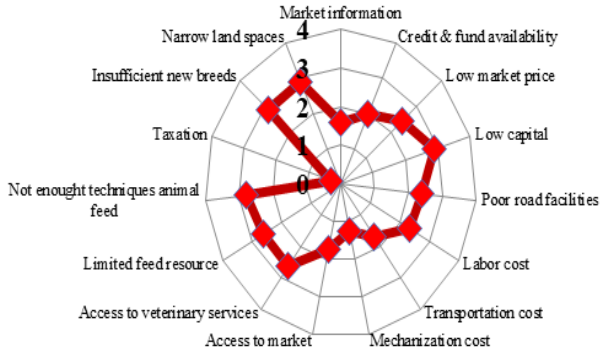


Figure 5. Socioeconomic constraints

The socioeconomic constraint also explicates why some farmers are not motivated or incapable of apply or adopt the recommended livestock management practice necessary to achieve better productivity. In the six selected district of Battambang province, the highest constraints perceived by farmer on the socioeconomic factors are: low capital and not enough techniques making animal feed (on average ranked approximately 3) as major issue of availability or access to factors. Another most important factor in socioeconomic constraints is limited feed resource, access to veterinary services, low market price, poor road facilities, and labor cost (averagely ranked 2). During the conducted survey interview, the farmer complained on the instability of market prices which are caused by middleman. Moreover, they complained on the heavy taxes levied on them.

Livestock unit (Lu) coefficient [21] is basically exchange ratio among different livestock species. This study adapts this conversion ratio converting other livestock into cattle referred to as livestock standard in cattle unit coefficients "lu" where one head of cattle is about 0.4 pig and 0.02 chicken.

After running the STATA command: biplot LowMarketPrice Heat LowCapital..…Disease PoorRoad, rowover(lu_group), the biplot (figure 8) was developing displaying 193 observations within 3 groups (lu_groups) and 24 variables (the constraints). The explained variance of livestock production variables of the first component (dimension 1) is about 23% and the second component (about 15%) giving a total explained variance of 38%.

The "rowover" distinguishes the perception of farmers in the different lu groups via highlighting plot for each group identified by equal values of constraints.

For simplicity and clear view, the biplot spitted for the different Lu groups (Figure 6 Figure 7 and Figure 8). Figure 6 presents the biplot for group 1, Figure 7 presents for group 2 and Figure 8 represent the biplot for group 3.

From these diagrams, it is clear that fewer farmers have Lu greater than 10. As mentioned in Table two, group 1 livestock is less than 10, group two Lu counts from 10 to 20 and group 3 from 20 and above. Intuitively, the groups with higher number of Lu are considered to be more productive than groups with lower Lu. The lengthy arrows indicate that there is high variance in the constraint's factors among the groups. Majority of the observations in the biplot concentrates at the left side of the diagram indicating that the constraints in that region are crucial to the farmers' productivity. The other few scattered groups at the right side majorly complained about the market information with low variance amongst themselves. This group has higher lu compared to other groups (at the left side of the biplot) they consider other constraints lesser than that of market information.

Table 1. Descriptive statistics of livestock productivities of the livestock unit in Cattle coefficients

Variable	Definitions	Range	Household	Mean	Std.	Min	Max
Lu_group 1	Livestock Unit: livestock standard in cattle unit coefficients where one head of cattle is about 0.4 pig and 0.02 chicken.	<10	156	5.6	2.2	0.4	9.8
Lu_group 2		10 -20	41	13.8	2.7	10.2	19.5
Lu_group 3		>20	6	27.3	5.9	21.9	36.7

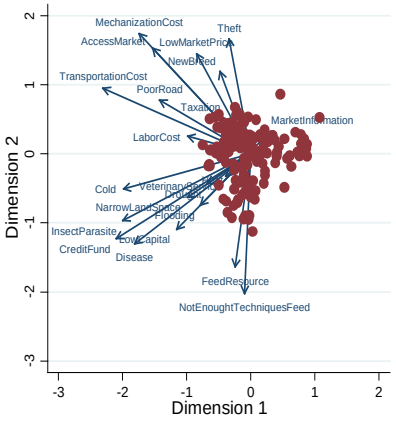


Figure 6. Biplot for group 1

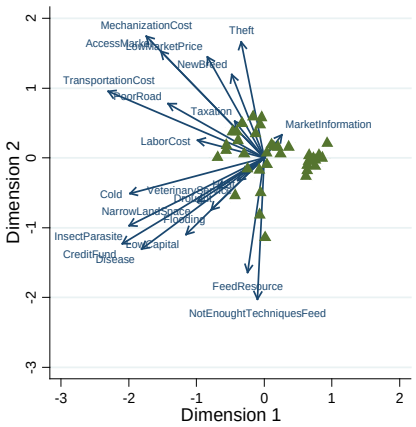


Figure 7. Biplot for group 2

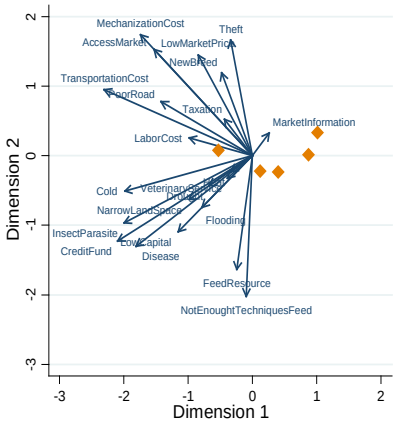


Figure 8. Biplot for group 3

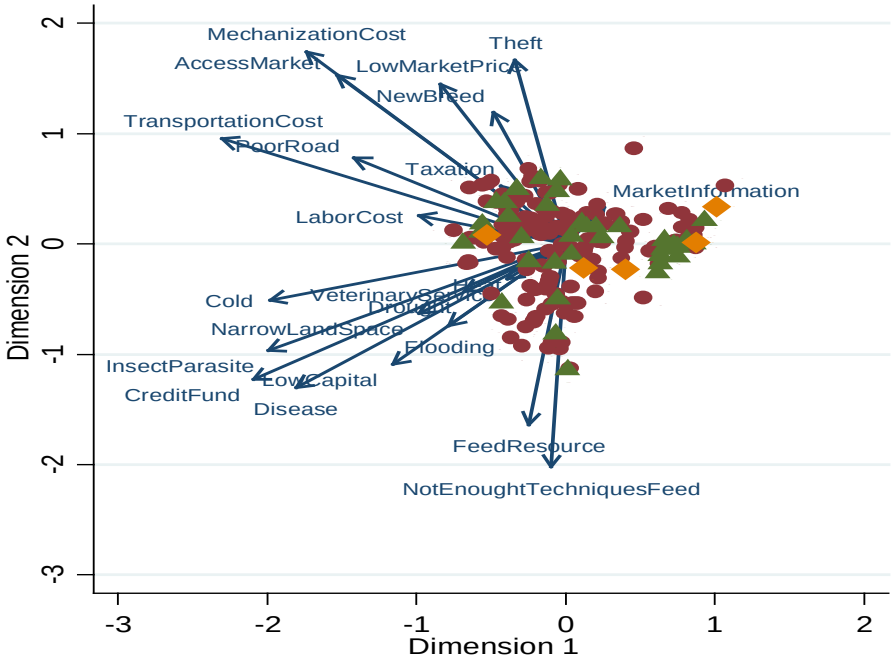


Figure 8. Biplot for all group of livestock constraints

Conclusion & Recommendations

The livestock production in Cambodia especially in the rural area has been facing so many challenges for the past decades, these challenges reflect on livestock, environment and human as well. This study investigates the abiotic, biotic and socioeconomic factors affecting livestock production of rural farmers in Cambodia. The result of the study reveals that the livestock productivity of rural famers are majorly diseases and parasites under the biotic category. The abiotic category on the other hand, precisely the heat stress, and drought has constantly been caused of low productivity in the region. The socioeconomic factors such as are low capital, poor breed and access to veterinary services, limited fed source, unavailability of new and better breeds, poor infrastructures etc. their famers are grouped into three, those with small, medium and large number of livestock (using a conversion ratio called Livestock Unit- LU). The farmers with small and medium livestock unit dominates the region of compliant about the influencing factors, more so, majority over 90% of the farmers are in these group. The farmers under the large livestock unit group particularly complained on poor or lack of market information as factor affecting their production. The outcomes of this research are specially suggested that more investment should be put livestock research especially on new breed to strengthening the livestock subsector, provision of capital to farmers after havocs, Strengthen the extension services on animal health and animal production and marketing development and put more investment in public animal healthcare.

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