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Household Attributes and Agro Diversity Across Different Land Holdings : A Case Study from Sihphir Village in Mizoram, India

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ABSTRACT

Land holding is a strong driver of household attribute, crop diversity and farm management. Present study explores its influence in Sihphir village, Aizawl district of Mizoram by considering three land holding categories *viz.* marginal land holding (MLH; < 1ha), small land holding (SLH; 1-2ha) and semi medium land holding (SMLH; 2-4ha). Household attributes and farm management were surveyed using a questionnaire on thirty households, while for farm diversity by laying plots in 15 farms under each category. Agriculture is the main occupation across land holding with education skewed to the lower levels among marginal land holders. The percentage of household members involved in agriculture and land allocated for agriculture decreased with larger land holdings. Piggery is the main livestock reared by all land holders with average number of pigs per household ranging from 1.96 ± 1.95 in MLH to 2.46 ± 1.97 in SLH. Total household income increased with land holding, but there was large variation in income from agriculture and livestock within each category with co-efficient of variation values above 50 per cent. A total of 55 food plant species were reported in all farms out of which 28 were trees and 27 herbs. The survey reports 17 species primarily used as source of fruits, 11 as a vegetable and 2 as spices. Tree density was highest in farms of the SLH category. *Cleodendrum infortunatum*is the most common species in all farms. Tree diversity and dominance indices across farms in various categories of land holding differed marginally in contrast to herbaceous crop species which showed the highest diversity in SMLH. Among the herbaceous crops, *Brassica nigra* had highest density in all categories. The management practices followed by different land holders did not vary significantly except for the tendency of saving seeds for the next season.

Keywords : Household income, Livestock, Agro diversity, Species richness

In rural societies, land is a prominent production factor and provides socio-economic and political stability to a household. Land holding has a multi-dimensional role providing food and nutritional security, income as well as future security against accidents and misfortunes. Agricultural land is vital for three out of four of the poorest billion individuals in the world, which depend on it and related activities for their subsistence (Anonymous, FAO, 2016). There are ample evidences to relate land holding with household income (Pramanik, 2022), education levels (Sharma *et al*., 2012), nutrition (Pritchard *et al.,* 2016) and overall food security (Joshi & Joshi, 2016 and Nkomoki *et al*., 2019). Such relationships are particularly strong in societies where land distribution is highly biased to those sitting in higher echelon and

prevailing customs prevent any break in the ownership cycle.

Size of land holding is a significant factor in controlling farm characteristic, input and management, whose effects resonate back to overall household attributes. Francesco *et al*. (2021) in a detailed analysis on studies made across 42 countries found positive correlation between agricultural diversity and the farm area. According to the earlier arguments given by Bhatta *et al*. (2016) and Makate *et al.* (2016), there is very less scope for crop diversification if land holding is small. On the contrary, Aheibam and Singh (2017) argued that farmers with low land holding are forced to diversify their crop resources to reduce risks and stabilize income. Larger landholding, in most contexts provides liberty to invest on capital intensive technologies (Sahu & Das, 2015 and Hurakadli & Gaddi, 2023), high input crop and farm management practices such as use of high yielding varieties, external fertilizers, freedom to test new technologies and crop combinations (Adjimoti *et al*., 2017).

Drawing from the above evidences, there appears to be marked differences in many household and farm attributes that can surface from land holding status within the farming community. According to a data paper on Global and Inequality by Bauluz *et al*. (2020), South East Asia is a region that shows one of the highest levels of inequality in land distribution with the top ten per cent of land owners capturing up to 75 per cent of agricultural land and the bottom 50 per cent owning less than two per cent. Treading along the insights of previous reports, this paper explores household attributes, agrodiversity and farm management practices across landholders in a village of Mizoram in north east India. Mizoram is a hilly state which shares its borders with neighboring states of Assam, Manipur, Tripura and internationally with Myanmar and Bangladesh. Mizo is an agrarian society with no hierarchical class distinction in social status and participation in the community life. Agriculture is the main occupation of people with an average landholding of 1.26ha (Anonymous, Statistical Handbook of Mizoram, 2022). However, there are limited marketing opportunities for agricultural produce because of the hilly terrain and poor road infrastructure. Given the above features and challenges in the state, the objective of the study is to investigate whether size of land holding can significantly influence the diversity of crops grown on a farm, farm management practices followed and the contribution of farm income to the total income of farmers. The results are expected to offer insights into the general characteristics of a typical Mizo household, specifically to understand influence of these attributes are influenced by the size of land holding.

Methodology

Study Site

The study area is in Sihphir village, 14 km north of Aizawl, the capital of Mizoram, which lies along 23.82 °N latitudes and 92.74 °E longitudes. As far as it is known the village came into existence in 1890s. The village is a densely populated permanent community with around 2000 households. The people in Sihphir mainly live in concrete buildings and some in assam-type houses. Most families own farmlands, but the size greatly vary from a few acres to tens of acres. Farmers generally follow a multi-cropping systems and farm produce include mustard, broccoli, cabbage, crowder pea/leaf, pumpkin, chilli, arum, tomato, pigeon pea, snake gourd, bitter gourd, bitter nut, bitter bean, orange, jackfruit, Macedonia, cucumber, betel leaf, etc and also many of them cultivated betel-nut palm.

Sihphir village experiences a mild subtropical climate characterized by warm summers with temperatures ranging from 25 to 30 °C (77 to 86 °F) and mild winters rarely dropping below 10 °C (50 °F). The village receives abundant rainfall during the monsoon season from June to September, averaging between 2500 and 3000 millimeters (98 to 118 inches) annually. This climate is favourable which supports diverse agricultural activities, including the cultivation of crops such as rice, maize, vegetables and fruits.

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Sampling and Data Collection

Household Attributes

The information about land holding and ownership was obtained from village council. Land was categorized into marginal land holding (MLH; < 1ha), small land holding (SLH; 1-2ha) and semi medium land holding (SMLH; 2-4ha). Due to low sample size, larger land holding was not considered for the study. The entire village was divided into three blocks and within each block, ten households under each land holding category were randomly selected. Survey pertaining to different household attributes which included respondent information, household member details, income sources, livestock asset, etc. were obtained using a structured questionnaire supplemented by semi structured interview for a total of thirty households under each category. Information on adoption of key management farm practices was obtained from all sampling units using a dichotomous questionnaire. The data from questionnaires were compiled and analyzed using MS Excel 2010.

Agrobiodiversity Survey

To study crop diversity 15 households were randomly selected from the list of 30 households from each category. Crop diversity was studied in the month of February 2023 by laying 10 plots of 10m x 10m for trees, within which 5 sub plots of 1m x 1m in each plot were laid for herbs. All trees and herbs under respective plots were identified and enumerated. Girth of trees was measured at breast height. The field data was analyzed for number of species and quantitative analysis of density per ha calculated. Crop diversity was calculated using Shannon and Wiener Index (1963) and the index of dominance of the plant community was calculated by Simpsons Index (1949).

Results and Discussion

Farming is the predominant occupation among all landholder categories with 96.67 per cent in marginal and small land holding and 90 per cent in semi medium land holding. Average family size was highest in the SMLH category (6.00 ± 2.31) and lowest in MLH (4.96 ± 1.80) with highest male-female ratio in the SMLH category and lowest in MLH (2.33 and 1.75, respectively). The education of respondents is skewed to the lower education level among the MLH group with not more than ten per cent studied beyond high school while SLH and SMLH categories had more than 30 per cent (Fig. 1).

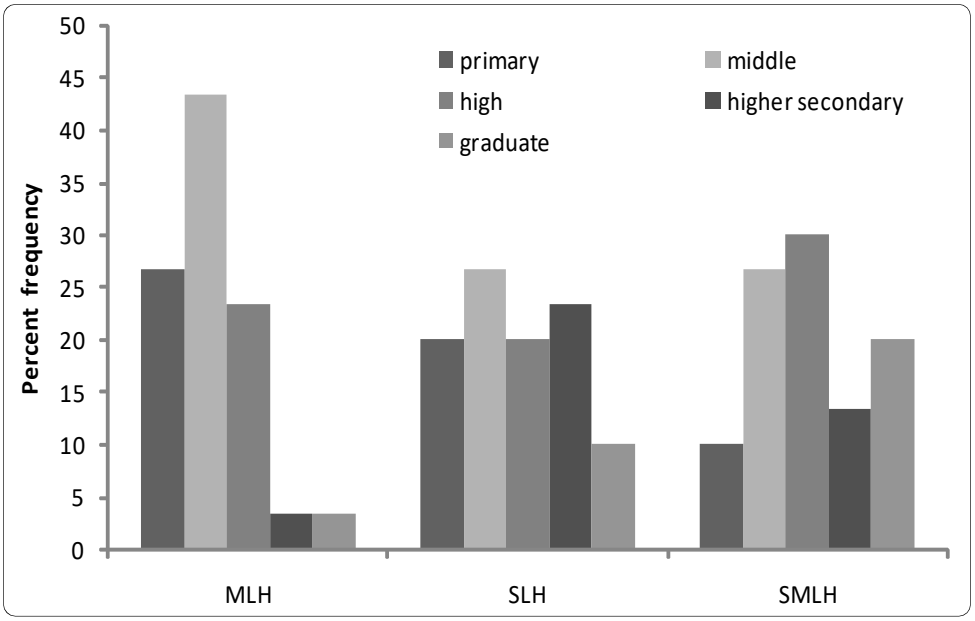

Fig. 1: Education level of respondents across different land holding status at Sihphir Village, Mizoram (MLH: Marginal Land Holding; SLH: Small Land Holding; SMLH: Semi Medium Land Holding)

Although the primary occupation of the residents was farming, only 42.28 per cent of the households members in MLH, 35.88 per cent in SLH and 35.59 per cent in SMLH category are involved in crop cultivation.

The average land holding of farmers was 0.67 ha, 1.50 ha and 2.96 ha in MLH, SLH and SMLH, respectively. In all categories owners allocated more than one fourth of their land for crop cultivation with figures decreasing in cases where entire land was used from MLH to SMLH (Fig. 2).

Poultry, pig and cattle are the types of livestock reared by the villagers the majority being pig (70 per cent and above) in the three categories. A very small percentage reared cattle, highest being in SLH (26.66

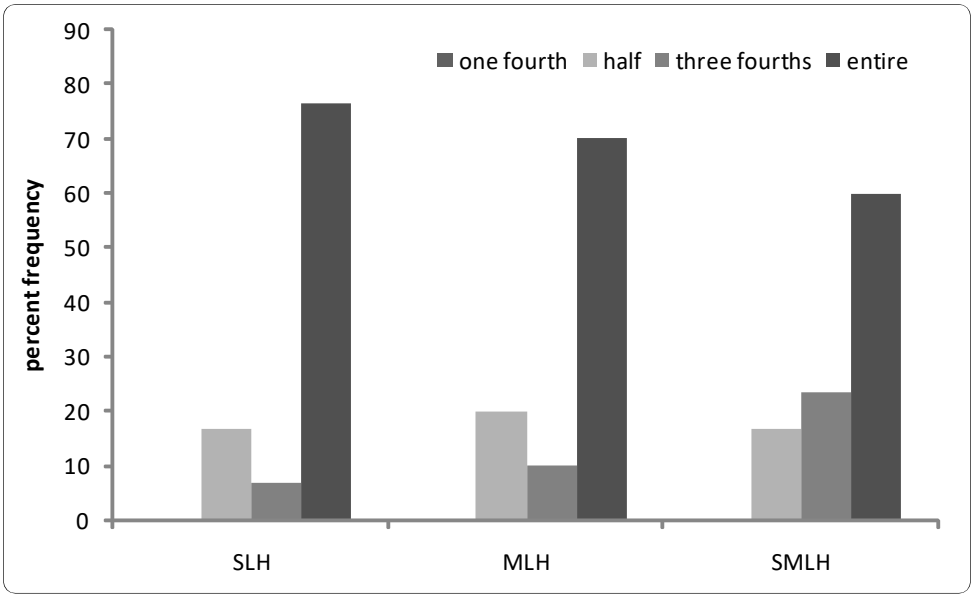

Fig. 2 : Percentage of household allocating land to agriculture across different land holding status at Sihphir Village, Mizoram (MLH: Marginal Land Holding; SLH: Small Land Holding; SMLH: Semi Medium Land Holding)

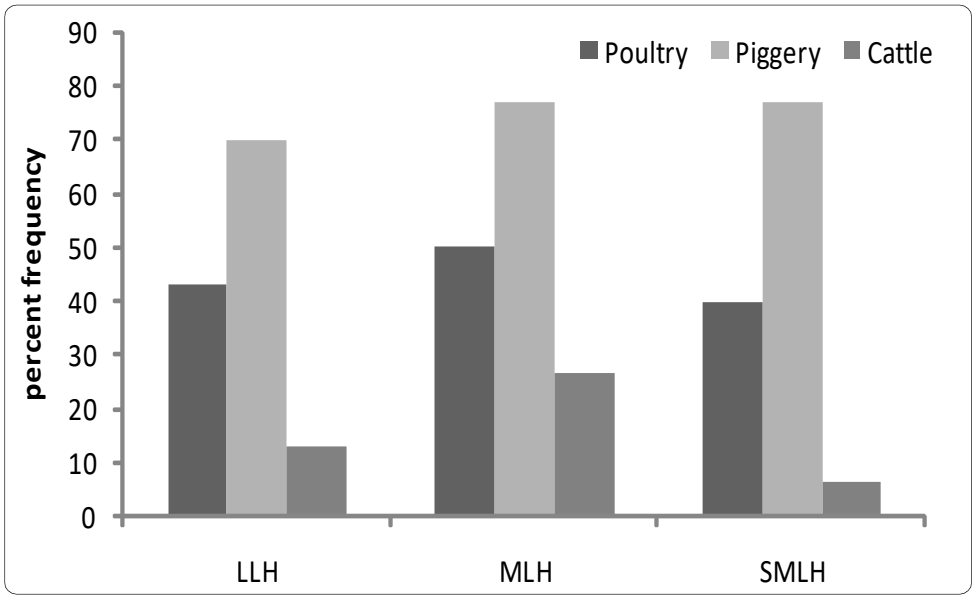

Fig. 3 : Percentage of household rearing different kinds of animals across different land holding status at Sihphir Village, Mizoram (MLH: Marginal Land Holding; SLH: Small Land Holding; SMLH: Semi Medium Land Holding)

per cent; Fig. 3). The average number of pigs per household was highest in SLH (2.46 ± 1.97) and least in MLH (1.96 ± 1.95).

There was an increase in average total household income with larger land holding. The contribution of income from crop to the total income also followed increasing trend with larger land holding yielding more income (Table 1). However, when income from livestock and crops were added together, their contribution to the total income was found highest in SLH (65.46 per cent), followed by SMLH (59.83 per cent) and MLH (54.27 per cent), with income from piggery contributing as high as 19.35 per cent in SLH category. Income contribution from cattle was not reported in any category. Overall there was large variation in income from crop cultivation and livestock within each category. The coefficient of variation for income from crop cultivation and livestock of MLH was 58.88 per cent, 70.28 per cent in SLH and 67.16 per cent in SMLH.

A total of 55 food plant species were reported in all farms, out of which 28 were trees and 27 herbs. Out of the 28 tree species, 17 were a source of fruit and the rest for vegetable while 11 herbaceous plants were used as a vegetable, 2 as fruit and rest for spice. The number of herb species recorded in farms ranged from 16 to 20 and that of tree species from 17 to 21 (Table 2).

Tree density was highest in farms of the SLH category (110 individuals/ha) and least in SMLH. Among tree species, *Cleodendron infortunatum,* a

Table 1

Annual income (in rupees) from different sources of household across different land holding status at Sihphir Village, Mizoram

Category	Crop	Piggery	Poultry	Crop and livestock	Service	Business	Others	Total income
Marginal land holding	138401 (33.70)	68723 (15.66)	11640 (2.65)	218764 (54.27)	28772 (6.55)	57658 (13.14)	133592 (30.44)	438787
Small land holding	178026 (40.66)	94592 (19.35)	35215 (7.23)	307834 (65.46)	42733 (8.74)	4716 (0.96)	133555 (27.32)	488840
Semi Marginal land holding	249241 (43.41)	70431 (11.85)	8490 (1.42)	325815 (59.83)	89040 (14.98)	109060 (18.35)	70198 (18.35)	594113

*Figures in parenthesis indicate percentage

Table 2

Diversity of tree and herb species in farms of different land holders at Sihphir Village, Mizoram

	Species number	Density per ha	Shannon Index	Simpson Index
Tree species				
Marginal land holding	17	90.00	1.03	0.14
Small land holding	21	110.67	1.11	0.1
Semi Marginal land holding	19	55.33	1.14	0.08
Herb species				
Marginal land holding	16	60826.67	0.72	0.31
Small land holding	20	52400.00	0.75	0.29
Semi Marginal land holding	17	69066.67	0.9	0.21

small tree is commonly found in farms across categories. In the MLH, species with high density were *Clerodendrum infortunatum*, *Psidium guajava* and *Dysoxylum excelsum,* while it was *C.infortunatum, P. guyjava* and *Areca catechu* in SLH and *A. catechu, P. guajava* and *Clerodendrum infortunatum* in the SMLH (Table 3).

Tree diversity and dominance indices across farms in various categories of land holding differed marginally (Table 2). Density of herbaceous species was highest

TABLE 3

Density of tree species per hectare in farms of different land holders at Sihphir Village, Mizoram

Species name	Common name	MLH	SLH	SMLH
Acacia pennata	Climbing acacia	2.67	-	0.667
Areca catechu	Supari	4	-	8
Arengapinata	Sugar palm	-	1.33	-
Artocarpus heterophyllus	Kathal	3.33	-	2.667
Artocarpus lacucha	Lakooch	-		0.667
Averrhoa carambola	Star fruit	1.33	-	-
Carica papaya	Papaya	-	0.67	0.667
Castanopsis tribuloides	Chestnut	-	-	0.667
Citrus aurantifolia	Kagzinebu	-	-	5.333
Citrus medica	Bara nimbu	2	4.67	-
Citrus sinensis	Musambi	-	0.667	2
Clerodendrum infortunatum	Hill glory bower	19.33	22.67	7.333
Cocos nucifera	Coconut palm	-	-	1.333
Coffea arabica	Coffee	3.33	-	-
Dendrocalamus longispathus	Rupohithekera	6	-	-
Dysoxylum excelsum	Indian white cedar	11.33	9.33	0.667
Garcinia spp	Rupohithekera	-	1.333	-
Macadamia	Thingsemim	-	2	-
Mangifera indica	Am	4	3.33	5.333
Musa ornata	Ornamental banana	3.33	1.33	2.667
Musa acuminata	Kella	-	-	2
Ostodes paniculata	Panicled bone tree	-	0.67	-
Parkia timoriana	Tree bean	10	8.67	2.667
Persea americana	Avocado	3.33	4	1.333
Phyllanthus emblica	Amla	3.33	4	2.667
Psidium guajava	Guava	9.33	10.67	7.333
Tamarindus indica	Imli	-	0.67	2
Trachycarpus martianus	Martius fan palm	2.67	-	-
Trevesia palmata	Snowflake tree	-	4	-
Zanthoxylum budrunga	Indian prickly ash	2	2	1.333
Leucaena leucocephala	Lead tree	-	2	0.667

in farms of Semi Marginal land holders (69066.67 per ha), followed by Marginal and small land holders (60826.67 per ha and 52400 per ha, respectively; (Table 2). There were also marked differences in the species diversity between farms of SMLH and those of SLH and MLH (Table 2). In the case of herbaceous species, *Phasoelus vulgaris* had highest density in all categories followed by *Solanum nigrum* in MLH, *Brassica nigra* in SLH and SMLH category(Table 4).

A survey on the conventional methods of farm management reveals that more than 90 per cent of the farmers in the study site use inorganic fertilizers (Table 5). The percentage of farmers having access to

Table 4

Density of herb species per hectare in farms of different land holders at Sihphir Village, Mizoram

Species name	Common name	MLH	SLH	SMLH
Acmella oleracea	Toothache plant	2893.33	2973.33	1160
Acmella paniculata	Panicled spot flower	-	-	4160
Ageratum conyzoides	Goat weed	2760	-	2133.33
Amaranthus viridis	Slender amaranth	840	-	5573.33
Amomum dealbatum	Java Cardamon	253.33	-	-
Brassica olearacea var. *capitata*	Cabbage	1920	1600	-
Brassica olearacea var. *italica*	Brocolli	3093.33	6480	5546.67
Brassica nigra	Mustard	33000	26480	28840
Capsicum frutescens	Chilli	-	13.333	-
Coriandrum sativum	Dhania	-	3693.33	3720
Cucurbita maxima	Pumpkin	2333.33	-	1173.33
Fragaria ananassa	Strawberrry	346.67	-	-
Glycine max	Soybean	626.67	40	-
Lablab purpureus	Hycinth bean	280	200	-
Luffa aegyptica	Sponge gourd	-	93.33	-
Lycopersicon esculentum	Tomato	133.33	-	53.33
Mentha arvensis	Pudina	640	-	-
Momordica charantia	Bitter gourd	-	266.667	213.33
Mormodica cochinchinensis	Spiny bitter cucumber	-	120	200
Ocimum americanum	Wild Basil	-	93.33	-
Phaseolus vulgaris	French Bean	3653.33	3586.667	6373.33
Piper sarmentosum	Betel leaf	-	120	-
Prunus virginiana	Bitter berry	-	40	66.67
Raphanus sativum	Mula	-	3466.66	3693.33
Selenicereus undatus	Dragon fruit	93.33	-	493.33
Solanum arthiopicum	Bitter tomato	-	40	-
Solanum nigrum	Black nightshade	7960	2693.33	2346.67
Trichosanthes anguina	Snake gourd	-	253.333	-

Table 5

Farm management activities (in percentage adoption) across households with different land holdings at Sihphir Village, Mizoram

Management Practices	MLH	SLH	SMLH
Inorganic fertilizer	90.00	96.60	100.00
Sprinkler system	16.77	16.77	10.00
Fencing	70.00	20.00	23.00
Purchase plant seed	23.00	33.30	63.00
Household using manures	6.60	0.00	0.00

sprinklers in their farms was also higher among the low and medium land holding category (Table 5). Farmers in the MLH and SLH tend to save seeds for the next seasons while SMLH farmers mostly purchased fresh seed (Table 5). In all the categories, small percentage of the farmers plant trees and use of animal-based manures was negligible.

The state of Mizoram lies in the southern tip of the north eastern region of India. The state is still considered to be remote in term of accessibility by road and railway construction is currently under way. Like many other north eastern state agriculture is the main occupation of rural households. Ninety per cent of the households was agricultural irrespective of the land holding, much higher than the overall state figure of 74.4 per cent (Anonymous, Statistical Handbook of Mizoram, 2022). Further, overall average land holding of farmers in the study area across categories was higher (1.61ha) than the overall district figure of 1.02ha (Anonymous, Statistical Handbook of Mizoram, 2022). The average land holding size in the marginal category is at par with state figure (0.67 ha as against 0.60 ha) while they were higher in the small and semi medium category (1.50 ha as against 1.28 ha and 2.96 ha as against 2.29 ha, respectively; Anonymous, Statistical hand book of Mizorzm, 2022). The figures under small and semi medium category are comparable with national averages of 1.41 ha and 2.70 ha (GOI, 2018). The state of Mizoram is under developed in terms of industrial establishment, tourism and service sector. Therefore, farming remains a dominant activity. Over 75 per cent of households in MLH category allocate their entire land towards farming, 70 per cent in the SLH and 60 per cent in the SMLH category. However, farming is not the only source of income. Evidence of income diversification can be observed that in more than 95 per cent of the all households less than 75 per cent of the members were involved in farming. This is further supported by the reasonably high percent income from other sources such as from government and private service, business and daily wage (50.14 per cent in MLH, 37.02 per cent in SLH and 45.15 per cent in SMLH). Off farm income is seen as a reliable strategy of averting risk or to cope with weather shocks among rural households (Pramanik, 2022), especially among the marginal land holders where production levels are subsistent and marketing channels are constrained. High coefficient of variation figures of total household income from agriculture and live stock within each category further implies large differences in usage pattern of land resource. We assume that there is a general lack of awareness among farmers of the various strategies to increase farm income through cultivation of valuable crops, farm diversification such as cattle rearing, integrated management and adopting proven technologies.

Although crop income increased with larger land holding, the income from piggery and poultry when added changed the pattern. The SLH farmers reared more pigs and poultry and obtained highest income from these two sources (Table 1). Piggery is a highly remunerative business in the state because of its huge demand. Pork contributes 71 per cent of total meat consumed in the state (Kumaresan *et al*., 2006). In addition, low cost of production (fed with kitchen waste and locally available plants), less land area required and minimum labour makes it one of the alternative livelihood options for many households. The income generated from piggery is higher than that reported from Dhemaji and Karbi Anglong districts of Assam which ranged between Rs.27701-34300 per annum (Janmoni *et al*., 2017).

North East India farms are characterized by diverse crop species that have supported the traditional lifestyle of the community and blends with the

landscape architecture. Compared to the many reports on overall plant species diversity of home garden in Mizoram that reveal high trees, shrub and herb richness (Sahoo & Pebam, 2015; Sahoo & Jeeceelee, 2015 and Barbhuiya *et al*., 2016) information on agro diversity which is directly linked to farmer food security and livelihood opportunities is absent. Drawing comparison to a study by Pandey *et al*. (2022) on the diversity of food system of Garo tribes of Meghalaya, we find that the crop diversity in the present study was much higher, 39 against 55, respectively. The crops categories included vegetable, fruits, spices and medicinal plants which indicate a diverse food basket for the households. While there was no marked differences in tree diversity across farm sizes, MLH and SLH farms had higher herbaceous diversity. Smaller landholders have a tendency to diversify their produce to meet nutritional needs (Malapit *et al*., 2015), avert risk and stabilize farm income (Aheibam & Singh, 2017) and also lesser land holding makes intensive cropping for commercial purpose non profitable (Adjimoti *et al.,* 2017). Herb and tree density in farms are seen to be inversely related. For instance, in farms of SMLH low tree density is compensated by high herb density and *vice versa* in the farms of SLH. *B. nigra* is found to be commonly and extensively grown in farms representing more than 50 per cent of crop cover in farms across all categories. Mustard is an obvious choice because of its tolerance to drought during the winter and offers good income to the farmers. Other crops include French beans, cabbage, coriander, brocolli. Sihphir village is recognized as one of the few pockets of Mizoram where commercial cultivation of vegetable crops is practiced (Singh *et al*, 2013) and since it is located close to the capital city, the produce is marketed easily.

Our approach to the present study was land holding size transforms into many household and farm attributes. Besides household attributes such as household members, level of education and family income (Fig. 1 and Table 1), differences in farm attributes were also observed. For instance, plantation tree species such as *A. catechu* and *C. sinensis* dominate farms of SLH and SMLH which were commercial and required crop management practices, whereas in MLH *P. timoriana* and *D. procera*, which were naturally found and required less attention, dominated the farms. *C. infortunatum*, a small tree species of 4-8 feet, was abundant in all farms. Leaves of the species is used as a vegetable and renowned against hypertension across different tribes of the north east India (Kalita *et al*., 2014) and reported to have many pharmacological properties (Lalrinpuia, 2018). The study reported the use of inorganic fertilizer by almost all households, perhaps because of the unavailability of animal manure due to the low livestock population, especially that of cattle (Fig. 3). Mizoram reported a dramatic increase in use of fertilizer between 2020-21 and 2021-22. Urea consumed in the state was 1113.69Mt in 2020-21 which shot to 8392Mt in 2021-22 (Anonymous, Statistical Handbook Mizoram 2022). Fencing was more common among households with MLH, presumably an apprehension against encroachment.

In many contexts, land is a measure of wealth that has overriding influence on many aspects of household, on and off farm activities. Although the opportunities for education, income generation, purchasing power, and crop choices can be witnessed among higher land holders, we failed to see this advantage being transformed in way of crop production, diversity and farm management practices. This is perhaps because all farmers irrespective of their land holding size continue to practice traditional multi cropping system with very low adoption rate of modern technologies. There is no large scale cultivation of high value crops even among the high land holders, the reason being limited marketing avenues and weak supply channels. The income from agriculture is less than 5 per cent of the Gross Development Product (Anonymous, Statistical Handbook Mizoram 2022). There is large scope for diversification of farm produce by way of diverting certain percentage of land area to high value crops and adoption of technologies for higher benefits and livelihood enhancement. Another promising enterprise is integration of livestock for commercial milk production and to promote use of organic manure in farms. Most importantly, there is a

great need for the state to improve transportation infrastructure to facilitate marketing of produce.

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