THE ROLE AND IMPACTS OF SMALL-SCALE, HOMESTEAD AGRO-FORESTRY SYSTEMS *("PEKARANGAN")* ON HOUSEHOLD PROSPERITY: AN ANALYSIS OF AGRO-ECOLOGICAL ZONES OF JAVA, INDONESIA[i]

The role and impacts of small-scale, homestead agro-forestry systems *("pekarangan")* on household prosperity: an analysis of agro-ecological zones of Java, Indonesia[ii]

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Abstract[1]

A survey of very small-scale homestead gardens in three Javanese provinces was conducted to analyze the potential beneficial effects on household's quality of life. Aspects included: (1) diet and nutrition, (2) income, (3) level of goods and material assets, (4) family status, (5) credit access, and (6) the role of women in managing production and marketing.

The survey encompassed sites on West, Central and East Java, representing a range of agro-ecological zones, watersheds (6), elevations, socio-cultural conditions and development stages. The plot sizes evaluated ranged from < 120 m^2 with no other agricultural land (OAL) to 120-400 m^2 with < 1,000 m^2 OAL. The average household plot size was about 240 m2 (with open space of at least 140 m^2) and OAL of 500 m^2. Around 5.7% of the sample villages were, by national standards, considered to be at an advanced development state, with 82.9% at a medium state, and with the rest least developed.

On average, very small homestead plots reduced food expenses by 9.9%. Nutritional benefits are primarily in the form of vitamin A and C – providing 2.4% and 23.6% of recommended dietary allowance (RDA), respectively and only 1.9% of either carbohydrates or protein. As contribution to *total household income*, average homestead output provides about 11% of total farm income, about 80% of which was derived from animal products such as chicken, eggs, fish and meat. As expected, plot size and value of household assets appear closely correlated and increase based on access to other agricultural land. About 55% of the households feel that social status would decline if the household lost access to their homestead land. The need for credit access is especially critical for the smallest lot owners. Women play the most important role in plot maintenance and plant-, animal- and fish production, and also manage family expenses for food, clothes, child health care and education. It appears that their role is less significant in managing family debt, and the purchase of agricultural inputs or other family expenditures. Overall, homestead gardens also perform an important social function. They help establish family and territorial identity, and facilitate neighborhood cohesion and beneficial communal interaction. It is suggested that agrarian reform programs that includes the distribution of land to landless people and small-scale homestead farms should be carried out in relation to the prevailing agro-ecological conditions and associated land carrying capacity and productivity ratings. Overall, such initiative should be within the framework of sustainable community development projects and well-defined regional economic development strategies. A minimum household plot size (e.g. 400 m^2) should be defined to accommodate an acceptable, future standard of living. This may be accomplished uniquely at the individual household level based on household ownership of plots, or possibly in combination with larger-scale communal garden systems with shared titles, individual plots and with associated benefits of economies of scale by reducing costs of capital-, material- and mechanized inputs, and value chain development that includes post-harvest storage, processing, packaging and marketing.

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Experience indicates that there is significant benefit in integrating diverse production system, such as food and cash crops, animal and fish production, especially in a closed-loop nutrient recycling system in combination with organic farming. Coupling agricultural with non-farm activities, including value-added enterprises, would provide for increased economic stability and potentially, and higher household revenues. In this approach, micro credit access assistance and the role of adaptive species selection, cooperative input acquisition, processing and marketing should be considered together with access to effective rural extension services. Research findings also show that some *pekarangan* owners have access to additional land cultivated to support household needs, and that this may be an important factor in land use intensification and the provision of sustainable income levels.

1. Introduction

Home gardening has a long tradition in many tropical countries, particularly in Indonesia (Arifin, 1998; Mitchell and Hanstad, 2004). Tropical home gardens comprise an assemblage of plants which may include trees, shrubs, and herbaceous plants or vines growing in or adjacent to a homestead (Landauer and Brazil, 1990). Arifin (1998) defines Indonesian home gardens (*pekarangan*) generally as a complex, species-rich agroforestry system -- a diverse mixture of perennial and annual plant species arranged in a multi-layered vertical structure, often in combination with livestock (Soemarwoto, 1987; Christanty, 1990), managed sustainably. A wide variety of multiple-use products can be generated with relatively low labor, cash or other external inputs (Christanty, 1990; Soemarwoto and Conway, 1992; Hochegger, 1998). In many densely populated tropical regions, *pekarangan* appear to be the last forest-like islands surrounded increasingly by extensive mono-cultivations of food crops. Research indicates that the multi-layered vegetation structure in *pekarangan* serves as an important habitat for wild flora and fauna (Kehlenbeck et al., 2006).

Pekarangan fulfill not only important ecological, but also many social and cultural functions (Arifin, 1999; Arifin, et al, 2006; Arifin et al., 1997; Arifin, Sakamoto & Chiba, 1998a; Arifin, Sakamoto & Chiba, 1998b; Arifin, Sakamoto & Takeuchi, 2001). They typify subsistence production and supplemental income generation, particularly in rural (Kehlenbeck et al., 2006) and transmigration areas (Mugnisjah, 1994). When located near forested areas, high production levels in *pekarangan* may help reduce deforestation (Mitchell, 2006). Furthermore, *pekarangan* can be considered as a model for sustainable agroforestry systems, integrating both economic and ecological benefits.

The sustainability of *pekarangan* depends, in part on the land use interface between biophysical (agro-ecological) regions and socio-economic-cultural domains. Ideally, they represent an interconnected micro system that is self-propagating, self-nourishing, self governing and self-fulfilling (Figure 1). Hence, micro landownership and land use structures (e.g. land cover/use mix, land access and security, and transformation) define the basic structure, current and future functionality of *pekarangan*, including their ability to supplement household needs. Macro-agroecological (climate, soil, topography and watershed) parameters in combination with socioeconomic attributes at the community and regional level, such as employment opportunities, wage rates, credit access, input availability and cost, production efficiency and marketing, are other important determinants.

Socio-economically, we may distinguish four basic functions of *pekarangan* (Kehlenbeck, Arifin, and Maass, 2007; Michell and Hanstad, 2004). First, subsistence production (Soemarwoto and Conway, 1992), such as a complement to staple crops, producing mainly fruits, vegetables, spices, and many non-food products (Karyono, 1990). Aside from crops, the system includes animal production, with high nutritional value in terms of protein, minerals, and vitamins (Soemarwoto and Conway, 1992), also contribute to food security in times or seasons of scarcity (Christanty, 1990; Karyono, 1990). Examples of production for supplemental income are provided, below (Fig. 2,3 and 4) They include spice crop production, animal pens integrated with homestead gardens, and nutrient recycling (Fig. 5).

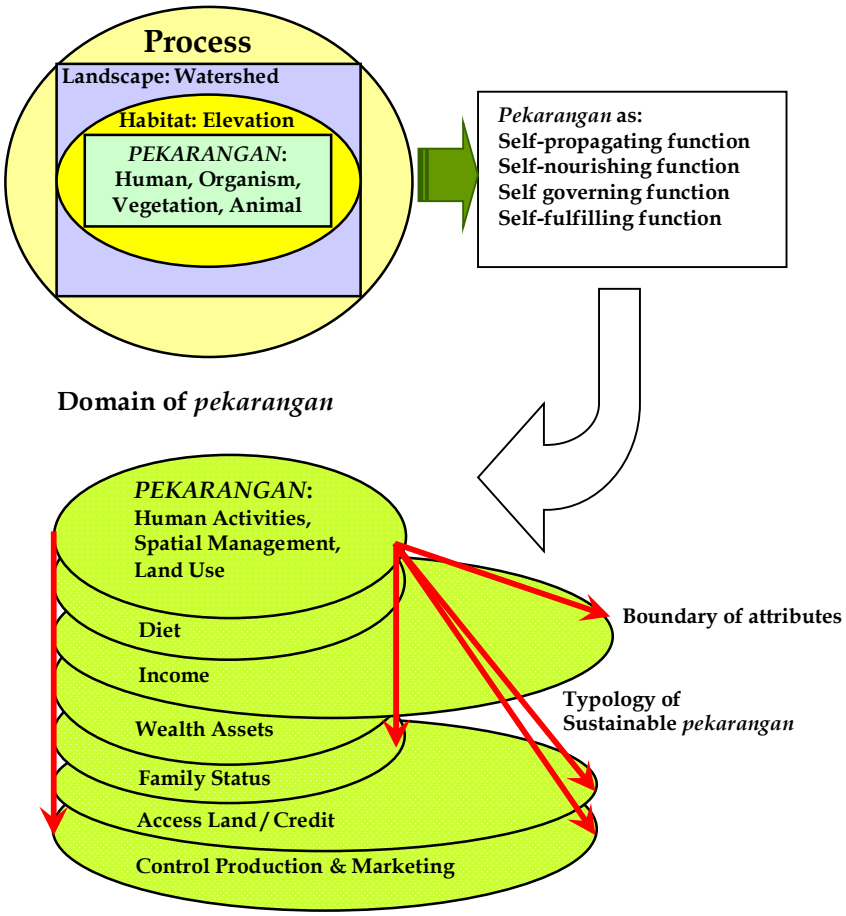

Fig. 1 - Structural and functional elements of *Pekarangan* Systems

Second, *pekarangan* can provide "commercial" production for supplemental income, particularly in regions with good market access and a well- functioning market. This includes perennial crops, such as fruit trees, cacao, and coffee. It may also include vegetables, ornamental pants and derived ornamental products, such as dried flower arrangements. Earlier research on Java indicated that this portion of income from *pekarangan* varied from 1 – 7 % (Arifin, Chozin, Sarma, and Sakamoto, 2006).

Third, *pekarangan* fulfill socio-culture functions. These include various service functions such as providing for the exchange of *pekarangan* products and planting material, establishing the household's status as land owners in the village, providing space for aesthetic and other service functions, such as the children's play yard, a place for neighbors to socialize (Arifin, Sakamoto, and Chiba, 1998b), a source as magical value (Abdoellah, Parikesit, Gunawan and Hadikusumah, 2002), and as a location for religious ceremonies. For instance, Hindu Balinese families need their *pekarangan* as a place for ceremonial sacrifices (Arifin et al., 2002).

Fig. 2 – Harvesting and Drying Spices Homestead

Fig. 3 – Integration of Animal Production and Garden Crops

Fig. 4 – Animal Production and Nutrient Recycling in Homestead Gardens

Forth, *pekarangan* fulfill ecological and environmental functions. Its multi-layered, vegetation structure resembles a natural forest and offers a habitat for a diverse community of wild plants and animals (Albuquerque, Andrade and Ceballero, 2005; Karyono, 1990). The integrated production systems of plants, livestock and fishponds provides for an efficient use of organic fertilizer and helps to recycle nutrients and reduces runoff and water contamination. Sometimes this is done especially effectively, such as the construction of poultry pens over fish ponds, providing for effective nutrient recycling and reducing potential water contamination by nitrates and phosphates (Figure 5)

Figure 5 – Poultry pens situated over fish ponds – efficient nutrient recycling (Schultink, 2006)

This survey was designed to investigate the benefits of *pekarangan* at their smallest scale. Specifically to look at the potential contributions to diet, income, household assets and status, access to credit and women's role in production and marketing.

2. Research goals, objectives and hypotheses

This principal research goal was to investigate impacts of *pekarangan* on household prosperity and to evaluate important social, economic and ecological functions. The research was limited to Java because here *pekarangan* are intensively used, and are fragmented and often decrease in quality due to population increases, changes in landownership, farmland degradation and deforestation. Such development plays an important role in the transformation of productive farmland on parts of Java. Rapid urbanization can especially be found in Java's northern coastal region with its impacts on agricultural development and rural-urban disparities (Winoto and Schultink, 1996). While these impacts are most significant locally, they include a worsening of structural conditions in agricultural land tenure, a deterioration of socioeconomic conditions in adjacent rural areas and increased income disparity.

The second research goal was to identify potential future roles of *pekarangan* in rural economic development, specifically in the context of a comprehensive agrarian reform program. Structurally, there are a large number of unused or underused land parcels in rural Indonesia. In a recent address, the Director General of the National Land Agency, Dr. Winoto declared that about 11 million hectares of "neglected" land exist in Indonesia. (Jakarta Post, April 3, 2009). In 2007, about 7.4 million hectares lay idle or were abandoned, mostly due to ownership disputes. Land access and ownership certification remains a major challenge. About 34 million Indonesians or about 34% of the population live below the poverty line (BAKOSURTANAL, 2009). It is also estimated that 56% of land and property is owned by only 1% of the population. The wide disparity in land access and household income, and the incidence of idle land productivity contribute to significant land policy challenge. In this context, the potential role of *pekarangan* in supplementing food, nutrition and income in rural areas, especially among the poorest households, is being investigated.

The research objectives of this homestead garden survey include: (1) measuring the household benefits associated with existing homestead plots, and (2) determining which factors may lead families to make more intensive use of homestead plots.

The following hypotheses were formulated:
(1) homestead plots produced significant benefits to the household diet.
(2) homestead plot produces significant benefits to the household income.
(3) homestead plot and the house are the family's most significant wealth assets.
(4) ownership of a homestead plot and house is significantly and positively correlated with the family status within the community.
(5) ownership of a homestead plot and house is significantly and positively correlated with the family's ability to obtain access to credit.
(6) female members of the household exercise significant control over production and marketing of the homestead plot products.

3. Research design

Pekarangan as a land use phenomenon is a dynamic concept. These homestead gardens - structurally and functionally --, reflect population dynamics, technology development, emerging land policies, institutional functions, culture, and the land inheritance system. Moreover, the productivity is influenced by agroecological variables such as soil texture (waterholding capacity), microclimate, topography and local drainage characteristics (such as position and elevation in the watershed). To study the dynamics, structure and functions of the *Pekarangan*, the watershed provides a reference point in understanding the role of sustainable land resources management. In most cases, a typical pattern of land use and landownership can be identified within the watershed, and landownership is an important determinant in community welfare.

Rapid urbanization with changes in infrastructure and land use is occurring in Indonesia, especially on Java. This process manifests itself by increased population densities, farmland degradation and deforestation. Agricultural sustainability is significant affected by this process (Winoto and Schultink, 1996; Yamaji, 2000). In addition, land fragmentation is caused by local heritage systems and has accelerated the use of smaller parcels of cultivated land and *pekarangan* (Arifin, 1998). Local customs, especially on Java, view *pekarangan* as a family resource to be shared by successive generations. This land fragmentation is exacerbated by local land development pressures. In combination, all these factors change the size, structure and function of *pekarangan* (Arifin, Sakamoto and Chiba, 1997).

At the aggregate, the total *pekarangan* land area in Indonesia is increasing but average parcel size is becoming smaller (BPS, 1997 in Arifin, 1998). The present scale of *pekarangan* may be classified as >1000 m^2 (very large), 500 m^2 – 1000 m^2 (large), 200 m^2 – 500 m^2 (average) and < 200 m^2 (small) – given the essential ecological functions, structure and plant stratification of *pekarangan*, the minimum size of *pekarangan* is taken to be 100 m^2 (Arifin, 1998a). Within this context, a survey and sampling frame were designed. Prior to final data collection, a pre-survey was used to finalize the questionnaire and sampling frame.

3.1 Site selection

The homestead survey was designed using sampling strata representing different agro-ecological zones. Strata represented location (elevation) and orientation within watersheds and soil parent material. This included Mt Salak-Halimun in West Java with rivers Cisadane (northern ward) and Cimandiri (southern ward); the Kelir mountainous area in Central Java with the rivers Tuntang (northern ward) and Progo (southern ward); and Mt Bromo in East Java with the rivers Kendil (northern ward) and Bondoyudo (southern ward).

Within the watersheds, samples were stratified based on three elevation levels representing climate variability, namely 0-300 m.; 300-700 m. and >700 m. above sea level. This selection primarily represents the wet adiabatic lapse rate of moist air and associated temperature and humidity variations. It also represents the practical differentiation as identified by Ochse, a Dutch horticulturist during the colonial era (as cited by Harjadi, 1989). He used this as a threshold between lowland and highland vegetation zones, indicating that above 700 m., coconut, a plant grown widely in Indonesia, could not be grown productively. The 300-700 m zone was used (Arifin et al., 2001) as a transitional zone, typified by a higher diversity of plant species as compared to the upper zone.

This research design is intended to more accurately represent how agricultural practices vary by agroecological zones as identified by Schultink's (1991) scheme. Observations confirm that wet and drier zones, as reflected in the survey plan, generate different land use systems. The wet (humid) zone is characterized by paddy fields, vegetables, fish ponds and other land uses conditioned by high water availability. The drier zone is typified by secondary crops (*palawija* such as maize, soybeans, ground nuts, root and tubers crops, etc.), animal husbandry and other land use patterns associated with less water availability.

In the respective zones, the sampling frame consisted of four groups of homestead ownership plot sizes, defined by random villages. They include G1 (< 120 m^2 homestead plot with no other agricultural land [OAL]), G2 (< 120 m^2 homestead plot with < 1,000 m^2 OAL), G3 (120-400 m^2 homestead plot with no OAL) and G4 (120-400 m^2 homestead plot with < 1,000 m^2 OAL). Represented samples were obtained by: (1) random village selection, (2) evaluating the *pekarangan* intensification practices through ground verification in a pre-survey, (3) defining the sampling frame of household holding *pekarangan* ownership and dominant land use practices, such as rice production, horticulture and other crops, animal husbandry and or fishponds; or absence of *pekarangan*. Only plots with *pekarangan* were included.

The homestead plots, as smallest sampling unit, were randomly selected within each watershed unit. The first level of selection was at the district level and based a topographical identification of the upper-middle-lower or mountain to lowland zones on multiple map scales (1:25,000 to 1:50,000) and other selection criteria such as: (1) the presence of settlements as land cover type within the district boundaries, (2) accessibility by village road, and (3) the representation of the district in the stratification zone. The second level of sampling unit selection involved the village level. Two villages within a selected district was randomly selected and verified by ground observation. Criteria included (1) its representativeness of community using *pekarangan* or homestead for agricultural (crop, perennial, livestock and fisheries based) and other supporting activities, and (2) its accessibility. Sampling sites were excluded if a village community culture and its resource availability did not support agricultural-based activities such as *pekarangan* and had no road access.

3.2 Sampling frame and process

Sampling frames were finalized by a pre-survey. Assisted by the *Kepala Dusun* (Head of Hamlet, informal leader), the team (1) conducted ground truthing to determine whether the majority of village used *pekarangan* (crop, perennial, livestock and fisheries) and other activities, (2) randomly selected a hamlet within a village, and (3) defined sampling frames within a hamlet. A total sample of 144 households was allocated to 3 Provinces, 6 Districts, and 35 Villages (36 Hamlets). Due to its large size and the steepness of its terrain, Sumber village in East Java has 2 hamlets representing upper stream and middle stream.

Four type of homestead plot were randomly selected from the sample frame list. In this survey, the sample frame was defined by interviewee that (1) had property right through acquisition or inheritance,

(2) used *pekarangan* for at least culturing fruit, other crop or perennials, cattle, cow, livestock or fish, (3) fell into one of the plot categories G1, G2, G3, G4, and (4) included less paved access. An example of the distribution of the sampling frame for a watershed is included, below (Figure 5)

The context of the survey reflects the agro-ecological variability found in the main parts of Java and socio-cultural differences. Cropping patterns in West Java reflects more humid condition than the eastern part of Java, as indicated by the existence of rice paddy (lowland) and as indicated by the species that more diversified (Harjadi, 1989). In *pekarangan* of West Java, Central Java and East Java the survey found 19, 6 and 4 local specific cultivated and edible species, respectively. Among those important were longan, mangosteen, gnetum (melinjo) and nutmeg (West Java), salak palm (Central Java) and maize (East Java). There were 15 species found in all three provinces. Among those that are important were coconut, guava, mango, papaya, banana, rambutan, chili and cassava. Other important plants found in two provinces were clove, coffee and durian.

The associated crop development plan (Table I) developed by the Center for Soil and Agroclimate Research and Development (2005) considers agroclimatic factors, service infrastructure, population density and edaphic factors. This scheme corresponds to crops found in the *pekarangan* survey. Although *pekarangan* do not purposely reflect such development plans, such correspondence may be viewed as a positive factor in promoting *pekarangan* intensification and in incorporating *pekarangan* as a part of rural economic development and agrarian reform policies.

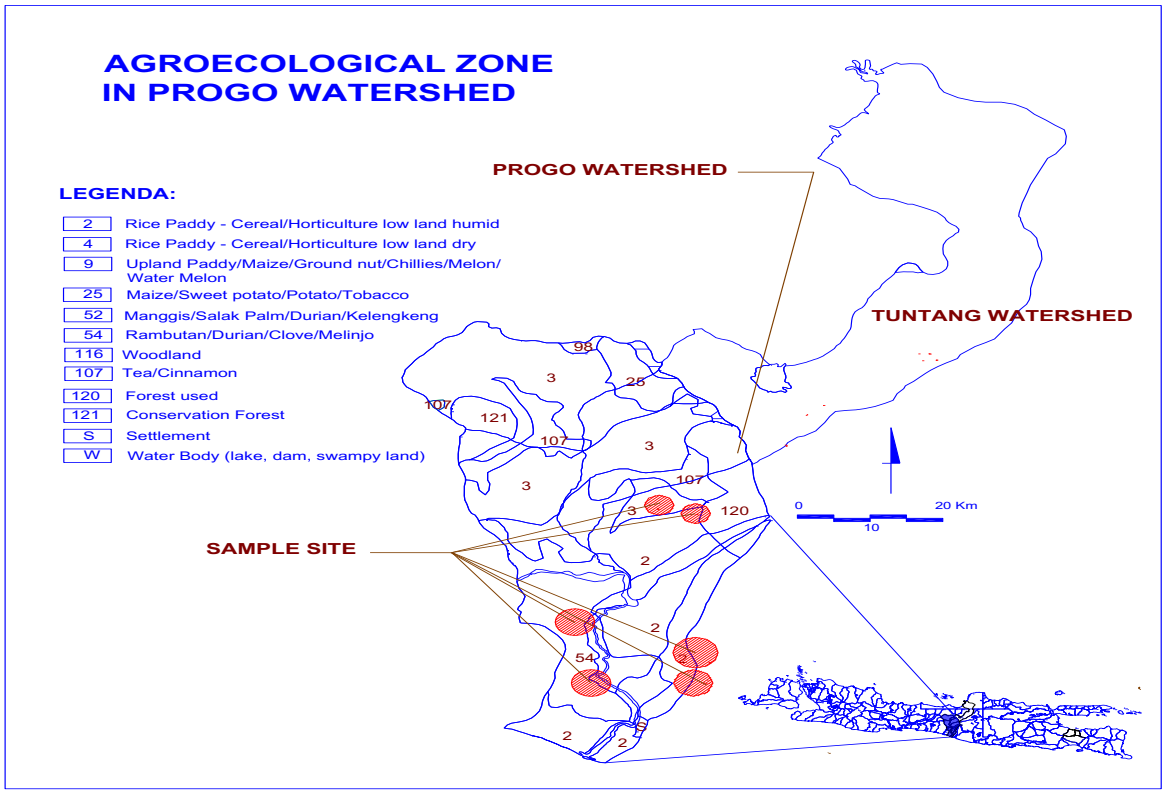

Fig. 6 – Example of Sample Site Distribution in Progo Watershed

Table 1. Agro-ecological Context of Homestead Plots (Study Sites). WS_1 -WS_6 reflect the transition from the more humid to the drier watersheds from West to East Java, respectively.

Contextual environment (Crop zone)	Legend*	climate		altitude		WS_1	WS_2	WS_3	WS_4	WS_5	WS_6
		humid	dry	low	high						
1. Rice Paddy	1	v	-	v	-	-	-	-	-	-	-
2. Rice Paddy - Cereal/Horticulture low land humid	2	v	-	v	-	v	v	v	v	-	v
3. Rice Paddy - Cereal/Horticulture high land humid	3	v	-	-	v	v	v	v	v	-	-
4. Rice Paddy - Cereal/Horticulture low land dry	4	-	v	v	-	-	-	v	-	v	v
5. Rice Paddy - Cereal/Horticulture high land dry	5	-	v	-	v	-	v	-	-	-	-
7. Upland Paddy/Maize/Chili	6	v	-	v	v	v	-	-	-	-	-
8. Upland Paddy/Maize/Ground nut/Chili/ Melon/Water Melon	9	v	-	v	v	-	-	v	-	v	-
9. Maize/Sweet potato/Potato/Tobacco	25	-	v	-	v	-	-	-	v	-	-
10. Mango/Salak Palm /Grape	45	-	v	v	-	-	-	-	-	-	v
11. Mangosteen/Rambutan/Salak Palm/Durian	48	v	v	v	-	v	v	-	-	-	-
12. Mangosteen /Salak Palm/Durian/Longan	52	v	v	v	-	-	-	v	-	-	-
13. Mangosteen /Salak Palm/Durian/Rambutan	53	v	v	v	-	-	-	-	-	v	-
14. Rambutan/Durian/Clove/Gnetum bean	54	v	-	v	-	-	-	-	v	-	-
15. Coconut/Cacao	62	v	v	v	-	v	-	-	-	-	-
16. Arabica Coffee/Orange/Avocado	66	-	v	-	v	-	-	-	-	-	v
17. Clove/Nutmeg/Woods	85	v	-	-	v	v	v	-	-	-	-
18. Clove/Nutmeg/Rambutan/Salak Palm/Durian	90	v	-	-	v	v	v	-	-	-	-
19. Clove/Gentum bean/Rambutan/Durian	96	v			v	-	-	-	-	v	v
20. Rubber	98	-	v	v	v	-	-	v	v	-	-
21. Rubber/Coconut oil	99	-	v	v	-	-	v	-	-	-	-
22. Tea/Cinnamon	107	v	-	-	v	-	-	v	v	-	-
23. Tea/Cinnamon/Cinnine	108	v	-	-	v	v	v	-	-	-	-
24. Woodland	116	v	v	-	v	-	-	v	-	-	-
25. Fishpond	119	v	v	v	v	-	-	-	-	v	-
26. Forest used	120	v	v	-	v	v	v	v	-	v	v
27. Conservation Forest	121	v	v	-	v	v	v	-	v	v	v

4. Survey results

The survey conducted in three provinces, spreading from west-to-east and north-to-south of Java, and representing a range and different environments, varying in agro-climatic condition, elevation and socio-cultural characteristics resulted in some important conclusions:

a. Homestead plots average contribution to household dietary needs and food costs was relatively low, on average 9.9%. In terms of nutritional needs, the plots contribute primarily to vitamin A and C, reaching 12.4% and 23.6% of recommended dietary allowance (RDA) respectively, and only 1.9% of either carbohydrate or protein. For the households which used their plots more intensively, dietary contributions were higher (in average 56.0%, and up to 69.6% higher). This suggests an unrealized potential for small *pekarangan* to contribute to household nutrition.

b. Homestead plots contributed on average 11% to the total household's income. The great majority (around 80%) of this income originates from animal products i.e. chicken, eggs, fish and meat. In the context of productivity (contribution to income) per square meter, farmers holding smaller plots were more efficient than farmers with larger plots. The bigger the size of un-built area and the closer to a water source, the higher contribution of *pekarangan* to income. A higher education level is associated with a lower contribution to income, indicating alternative income potential for the more educated households. A larger size of un-built area, particularly those with no OAL, is associated with a larger income contribution. Furthermore, on the average, income from animal production was positively

correlated with size of un-built area and occupation of head of household and negatively correlated with number of unmarried children. For the households that used their plots most intensively, the contribution to income 20.9%, which suggests that there is an unrealized potential for small *pekarangan plots to contribute to household income.*

c. Aside from potential assets in land and buildings that may be certified in land titles, the principal household wealth assets are items such as radios, televisions, watches or clocks and mobile phones. Ownership of larger homestead plots is associated with a greater number of these assets. Additional property (OAL) had no significant correlation to total assets. Moreover, there were only 4 kinds of business assets held by farmers i.e. (1) sprayers/dusters (1.4%), (2) small equipment as sickles, axes, hoes etc. (88.9%), (3) storage facilities (1.4%) and (4) pump (5.6%). Statistical analysis showed significant correlation between (1) homestead plot size and the value of farmer's assets and (2) availability of OAL and the value (rupiahs) of farmer's assets. The larger the plot, the higher the assets value and the more available OAL contribute to the higher assets value.
d. Family income (independent variable) is positively correlated with the amount of money borrowed (dependent variable) for small plot owners.
e. Women play important roles in managing homestead plots, primarily in plant production rather than in animal and fish production. Related activities include crop selection, plant selection, planting, maintenance, harvesting and marketing. Women's primary roles are in crop management (74.8% of households) and harvesting (55.7%), with smaller role in marketing (36.6%). There was no significant difference among groups. In using money, women have important roles in managing family expenses for foods, clothes, children's health care, and children's education. Again, these roles were not significantly different among groups. Women's role in using money to pay debts, buy agricultural production inputs and other spending, were less significant.
f. Homestead plots serve other social purposes. They facilitate social gatherings and community interaction, and provide for a loosely-controlled demarcation and personalizing of personal properties.

5. Relevance of more detailed findings

To improve the prosperity of the rural landless, the Government of Indonesia, particularly the National Land Agency (BPN), plans to provide land for rural community development through land and access reform (Winoto, 2007). Potential land resources include (1) land surrounding villages in access of certain size, (2) abandoned or underutilized land, and (3) concession land administered by government agencies.

The survey results provide input on the selection, potential benefits and implementation of land allocations in a national agrarian reform program. As such, it complements and addresses generic and specific criteria, as identified by Winoto (2007). These includes, as basic recipient criteria, (1) Indonesian citizenship, (2) poor economic status, (3) over 18 years of age, (4) highly motivated, (5) residing in the recipient sub-district, and (6) with less than 15 million rupiahs in assets (about $1500 in 2009 exchange rates). Five additional priority criteria are identified by BPN, namely (1) landless status, (2) number of family members, (3) duration of residence, (4) relevant job experience, and (5) level of education. In part, these factors are addressed in the survey results, such as (1) plot size, (2) aspects of plant, livestock and fish cultivation, (3) involvement of women in agriculture production, and (4) level of motivation.

The survey results reveal a number of relevant characteristics of these homestead garden plots that are helpful in defining potential agro-forestry system parameters and there relative contributions to family prosperity and nutrition (Figures 7, 8 and 9).

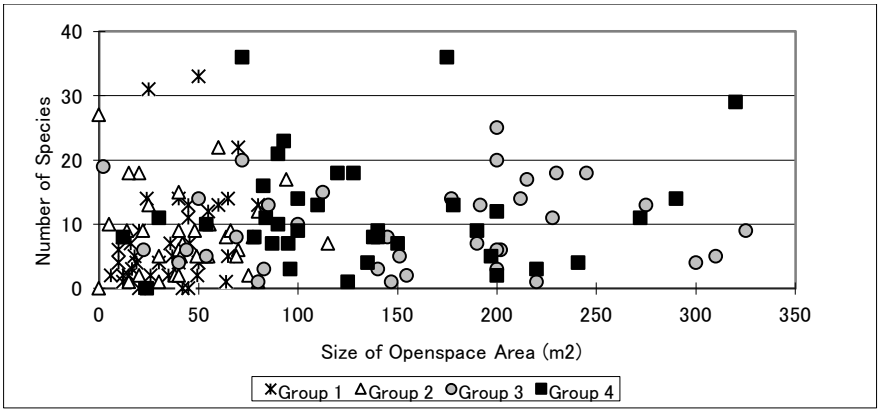

Figure 7 - Scatter Plot of Size of Open Space Area and Number of Species (Including ornamental species)

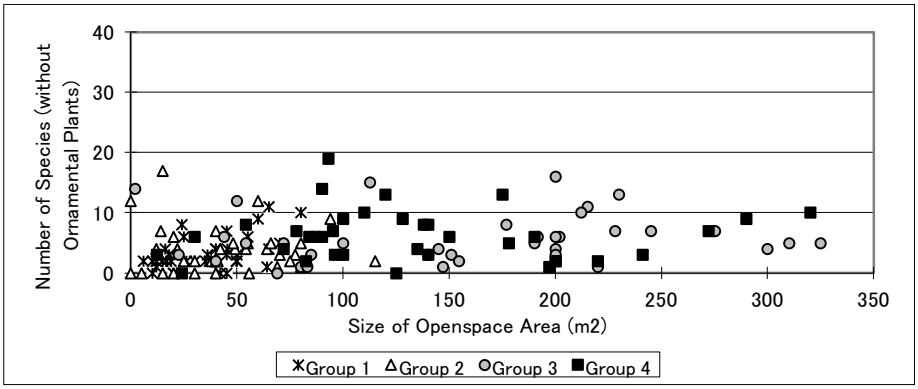

Figure 8 - Scatter Plot of Size of Open space Area and Number of Species (Excluding ornamental slants)

Figure 9. Pekarangan (G-1) shows varies crops and plants functions and multi-strata of vegetation as part of an agroforestry system (Arifin, 2006)

The relative distribution of plant species by land use is described below (Table II). In the communities surveyed, plant production for dedicated medicinal use, spices and other use (see below) is not significant.

Table II - Distribution of *Pekarangan* Plant Species by Category of Uses

Category of plant uses	Out of 196 species (%)	Out of 24 species (%)
Starchy	2.55	8.33
Fruit	14.80	20.83
Vegetable	10.71	12.50
Spices	4.59	-
Medicinal	6.63	-
Industrial	4.08	12.50
Ornamental	52.55	45.83
Others*	3.57	-

*Others: plant species for fuel, handicraft material and shade , e.g. bamboo, mahogany and other woods

Livestock holdings, specifically chickens, are a significant component of these agro-forestry systems (Table III). Smaller holdings (G1 and G2) have, with the exception of fish and ornamental species, as many animals as the larger categories (G3 and G4). The smallest and poorer group (G1), with no other land and presumably the poorest has the largest # of chickens.

Table III. Number of animals at G1, G2, G3 and G4

No	Animal	G1	G2	G3	G4	Total
1	Cow for milk	3	2	8	2	15
2	Cow for meat	10	20	11	8	49
3	Goat	63	51	51	31	196
4	Sheep	1	17	18	22	65
5	Chicken (broiler)	23	13	10	8	54
6	Chicken (local)	182	117	145	128	572
7	Duck	29	10	31	14	84
8	Manila duck	5	20	39	8	72
9	Rabbit	2	7	4	15	28
10	Fish	0	130	5,445	2,520	8,095
11	Ornamental fish	0	20	570	0	590
12	Ornamental bird	5	23	27	27	82
13	Pets (cat, dog)	1	7	5	5	18

The most abundant plant species planted in homestead plots is banana (Table IV). Plants present in at least 25% of *pekarangan* households are guava, mango and ornamental plants (dracaena and coleus). Cassava and tuber crop (such as sweet potato) are cultivated by 13% and 10% of the total. Fruit trees dominate, such as banana (47%), papaya (24%, guava (29%), and mango (34%). Chili peppers and jengkol (*Pithecollobium jeringae)* were cultivated by only 18% and 10% of respondent, and tomato was cultivated by 8%. Many annual vegetables such as shallot, celery, tomato, eggplant, yard long bean, spinach, water spinach (*kangkung, Ipomea aquatica*), *katuk (Sauropus androggynus)* were cultivated by less than 8% of housholds.

Table IV- Relative Abundance and Productivity of Plant Species (N=144)

No	Plant Species		Frequency* (%)	Potential range of Productivity (kg/1000m^2/year)
	Common name	Latin name		
1	Cassava	*Manihot utilissima*	19 (13.2)	69.0-90.9

2	Sweet potato	*Ipomoea batatas*	14 (9.72)	26.4-31-3
3	Banana	*Musa paradisiaca*	67 (46.5)	131.5-412.0
4	Papaya	*Carica papaya*	34 (23.6)	209.7-447.9
5	Guava	*Psidium guajava*	42 (29.2)	135.9-170.4
6	Mango	*Mangifera indica*	49 (34.0)	224.4-1,536.4
7	Orange	*Citrus sp*	22 (15.3)	70.4-228.9
8	Tomato	*Lycopersicon esculentum*	12 (8.3)	16.2
9	Chilli	*Capsicum annum*	26 (18.1)	73.2-121.5
10	Jengkol	*Pithecollobium jeringae*	14 (9.7)	n.a
11	Coconut	*Cocos nucifera*	20 (13.9)	215.5-265.8
12	Coffee	*Coffea sp*	14 (9.7)	20.7-84.8
13	Cacao	*Theobroma cacao*	17 (11.8)	n.a

Thirteen out of 24 species were non-ornamental plants and their relative productivity could be identified. Other abundant crops/plant (11 species) were ornamentals namely *Hibiscus* (n=14), *Codiaeum sp* (n=10), rose (n=15), *Dracaena* (n=35), *Acalypha* sp (n=15), *Caladium* (n=10), *Coleous* (n=28), *Aglaonema crispum* (n=22), *Anthurium scherzeranum* (n=13), *Cactus* (n=11) and *Dieffenbachia* sp (n=13).

The source of non-pekarangan land acquisition varies from inheritance, to purchase and land reform. Hereditary acquisition is the most prevalent (Table V).

Table V. Acquisitions of (non-pekarangan) farmland

Group	**Acquisition (%)**				**Time of the Ownership (years)**
	Purchased	**Inherited**	**Land Reform**	**Other**	**Average**
G2	9.7	36.1	1.4	2.8	17
G4	18.1	31.9	0.0	0.0	13
Total	27.8	68.1	1.4	2.8	15

With respect to landownership and registered land titles or certificates, there are two kinds of certificates: the formal certificate issued by BPN and the informal certificate (*girik*) issued by village government. In the communities surveyed, of the 72 owners of non-*pekarangan* land, 47 (65.3%) have a formal certificate of ownership. The names on the certificates are in 61.7 cases the male head of household, followed by the husband's family (17%), the wife (8.5%) or wife's family (8.5%), female head of household (2.1%) or step child (2.1%).

Table VI – Ownership of OAL (other agricultural land) and status of certificate ownership

The right to sell the OAL		**Status of Certificate ownership (%)**		
		Formal	***Girik***	**Total**
G2	Yes	41.7	19.4	61.1
	No	19.4	19.4	38.9
G4	Yes	58.3	11.1	69.4
	No	11.1	19.4	30.6
Total		32.6	17.4	50.0

Relative food family expenses are identified in the following tables (VII and VIII). The major food expenses are for rice, milk, sugar, and edible oil. The biggest food expense was for rice with an average of household consumption of 132,349 rupiahs/household/month. The expense for sugar was 23,941 rupiahs/ household/year and for milk was 24,244 rupiahs/household/ month.

Table VII – Monthly Food expenses for carbohydrate sources, sugar, and milk (rupiahs/household/ month) (N)

No	Food Expenses	Expense (Rp.)				
		G1	G2	G3	G4	**Average** (by food type)
1	Rice (n)	134,219 (36)	119,136 (35)	140,819 (36)	135,007 (35)	132,349 (142)
2	Wheat (n)	22,350 (23)	14,902 (23)	7,870 (23)	5,816 (29)	12,311 (98)
3	Maize (n)	17,564 (14)	17,550 (10)	12,306 (9)	6,286 (7)	14,404 (40)
4	Other cereal (n)	2,000 (1)	2,325 (8)	1,000 (2)	3,750 (6)	2,525 (17)
5	Cassava	6,073 (13)	4,950 (10)	4,610 (10)	1,825 (16)	4,158 (49)
6	Sweet potato (n)	8,068 (11)	5,143 (7)	5,938 (8)	2,650 (10)	5,521 (36)
7	Pulses (n)	21,391 (11)	4,142 (12)	10,167 (12)	8,333 (9)	11,773 (44)
8	Tubers (n)	3,000 (1)	2,667 (3)	933 (3)	1,167 (3)	1,730 (10)
9	Sugar (n)	27,543 (35)	21,347 (35)	22,867 (36)	24,037 (35)	23,941 (141)
10	Milk (n)	21,077 (13)	25,167 (6)	46,400 (9)	13,327 (15)	24,244 (43)
11	Milk product (n)	0 (0)	0 (0)	0 (0)	10,000 (1)	10,000 (1)
12	Edible oil (n)	18,227 (35)	13,806 (35)	16,886 (35)	12,678 (36)	15,380 (141)

The household expenses for other food sources included tea and coffee, vegetables, and salted fish. Notably, expenses for cigarettes are the second highest in Table VIII. Expensed for animal protein such as fish, eggs, and meat was relatively low.

Table VIII - Expenses of G1, G2, G3, G4 for meat, fish, eggs, vegetable, fruit and cigarettes (rupiahs/household/ month) (N)

No	Food Expenses	Expense (Rp.)				
		G1	G2	G3	G4	**Average** (by "food" type)
1	Meat (n)	132,500 (6)	109,750 (4)	32,667 (9)	71,857 (7)	78,115 (26)
2	Fish (n)	23,661 (14)	23,000 (14)	30,107 (14)	26,446 (13)	25,792 (55)
3	Salted fish (n)	26,161 (28)	17,304 (28)	16,169 (29)	12,968 (31)	17,999 (116)
4	Eggs (n)	16,123 (26)	20,370 (28)	17,991 (28)	21,842 (28)	19,207 (31)
5	Tea, Coffee (n)	13,558 (33)	4,912 (33)	9,983 (29)	14,363 (34)	10,755 (129)
6	Salt and spices (n)	4,276 (35)	5,342 (36)	3,810 (34)	1,831 (35)	3,826 (140)
7	Potatoes (n)	5,125 (16)	6,667 (15)	8,020 (15)	5,250 (18)	3,687 (64)
8	Vegetable (n)	15,875 (32)	15,752 (27)	18,378 (27)	16,194 (31)	16,509 (117)
9	Fruits (n)	24,579 (19)	9,575 (20)	13,500 (18)	20,971 (17)	17,000 (74)
10	Cigarettes (n)	73,780 (25)	65,635 (26)	67,107 (28)	90,696 (28)	75,210 (107)

Relative nutritional contributions are identified in Table IX. *Pekarangan* production contributed 137.8 kcal energy (1.97 %), 4.0 g protein (2.0 %), 158.0 IU (12.5 %) and 40.2 mg Vitamin C (23.70 %) per family. Nutrition contribution from *pekarangan* to recommended dietary allowance (RDA) was 1.89 % energy, 1.92 % protein, 12.39 % Vitamin A and 23.63 % Vitamin C.

Table IX - Family's nutritional requirements met by *pekarangan* output per day

Group	Calorie			Protein			Vitamin A			Vitamin C		
	kcal	To Total (%)	To RDA (%)	gram	To Total (%)	To RDA (%)	IU	To Total (%)	To RDA (%)	mg	To Total (%)	To RDA (%)

G1	52.9	0.82	0.92	1.8	0.97	1.09	78.7	10.09	11.35	18.7	15.61	17.56
G2	107.9	1.40	1.64	2.5	1.20	1.41	104.4	11.59	13.60	52.6	23.48	27.57
G3	181.9	2.59	2.09	4.6	2.57	2.07	98.8	15.99	12.87	45.8	25.23	20.31
G4	208.6	3.05	2.90	7.1	3.25	3.10	87.2	12.31	11.73	43.7	30.49	29.06
Average	137.8	1.97	1.89	4.0	2.00	1.92	92.3	12.50	12.39	40.2	23.70	23.63

Income generation op *pekarangan* in the samples across agro-ecological zones ranged from Rp 6.7 – 11.5 million, as compared to the national average household of household expenditures of around Rp 21.0 million per year (about US$ 2,100 at 2009 exchange rates). As contribution to *total household income*, homestead output provides about 11% of total household income, on average with the great majority (80%) from the animal production. Although relatively low, for the 25% of the households that use their plots most intensively, pekarangan contributes significantly to household income (20.9%). This suggest unrealized potential for small pekarangan to contribute to the income of rural households

On a per square meter basis, the smaller plots (G1 and G2) are more productive, producing an average of Rp 26,214 per square meter of open area, as compared to an average of Rp 18,863 per square meter for the larger plots (G3 and G4) or about 40% more productive.

Table X - Total and per square meter income originated from homestead plot

Source of income in *pekarangan*	**G1**	**G2**	**G3**	**G4**	**G1&G3**	**G2&G4**	**All group**
	Income (Rp/year) from a *pekarangan*						
Crop	33,215	111,458	239,833	160,250	136,524	135,854	136,189
Animal	538,506	679,917	1,275,806	909,083	906,931	794,500	850,715
Sale or leasing goods	38,500	57,778	119,972	252,375	79,236	155,076	117,156
Crop and animal	571,271	791,375	1,515,639	1,069,333	1,043,455	930,354	986,905
Crop, animal and sale or leasing good	609,771	849,153	1,635,611	1,321,708	1,122,691	1,085,431	1,104,061
	Income (Rp/year/m^2) from a *pekarangan*						
Crop	1,294	1,709	10,198	1,523	5,746	1,616	3,681
Animal	17,034	26,500	15,246	6,951	16,140	16,726	16,433
Sale or leasing goods	2,406	3,484	631	2,177	1,519	2,830	2,175
Crop and animal	18,329	28,209	25,444	8,474	21,886	18,342	20,114
Crop, animal and sale or leasing good	20,735	31,693	26,075	10,651	23,405	21,172	22,288

One of the key issues in agrarian reform - and the (re)distribution of land or the certification of (informal) ownership - is the latent use of "dead assets" tied up in unregistered land titles. This prevents or limits the use of land as collateral in farm loans and in practice results in excessive interest charges. In Indonesia, it is not uncommon for farmers to pay interest charges of 30-40% per year on small farm loans that provide badly needed operating capital or are used for capital improvements. Although this research does not test this question, specifically, it can be seen below (Table XI) that informal credit access is the prevalent condition for all homestead properties, across agro-ecological zones, resulting in excessive interest charges and is therefore a constraint in mobilizing latent productivity.

Table XI - Homestead farmers' response to the availability of formal and informal credit

Sources of formal and informal credit	**G1 (%)**	**G2 (%)**	**G3 (%)**	**G4 (%)**	**Average (%)**
Formal credit:					

• KUD	30.6	22.2	25.0	27.8	26.4
• BRI	25.0	30.6	27.8	27.8	27.8
• Village Bank	13.9	11.1	11.1	8.3	11.1
• Others	2.8	2.8	5.6	5.6	4.2
Total	72.3	66.7	69.5	69.5	69.4
Informal credit:	27.7	33.3	30.5	30.5	70.6
• Informal lender	89.3	61.3	75.0	68.0	73.4
• Other	10.7	38.7	25.0	32.0	26.6
Total	100.0	100.0	100.0	100.0	100

5. Recommendations

A comprehensive agrarian reform program that provides government-initiated restructuring of the agricultural sector, including the provision of land access to and distribution of underutilized land to landless people and smallholders is essential for rural economic development and revitalization. Such strategic initiative can be combined with microcredit where needed, extension services, farming cooperative ventures and value chain development as critical building blocks to increase economic opportunity and rural prosperity. The conversion of underutilized land to small homesteads with agro-forestry gardens or *pekarangan* provides a distinct and vital opportunity to increase income, nutrition and social status of the rural disenfranchised. Microcredit could be made available widely in combination with a viable and strategic land distribution scheme, customized based on local needs, agro-ecological settings, land qualities, tenure regimes and political realities.

In addition, credit sources should also be mobilized for community development to address opportunities along the value chain from production to processing and marketing, exemplified in the farm-to-food model. Household credit should be used to provide funds for farm inputs and capital improvements, with primary emphasis on increasing land productivity, and secondarily induce cooperative input procurement, processing and marketing. To enhance community prosperity, creditors (banks, cooperatives or NGOs) should develop small scale-oriented credit schemes that provide credit to both market-oriented and subsistence households. Community development should be based on innovative approaches to community management such as participatory management, and could include communal landholdings where customary land right prevail.

The role of homesteads in such agrarian reform program in Indonesia includes the following recommendations:

- Homestead plot development and agrarian reform program should be conducted in the context of agro-ecological land suitability and based on regional development plans
- The program should be conducted in consultation with stakeholders (in the design, planning, funding and implementation) as a comprehensive and sustainable community development program
- Homestead plots should be utilized for either agroforestry or non-agriculture based activities. Considering the low educational years of experience, either agriculture or non-agriculture activities should be nurtured by technical assistance provided by dedicated agriculture extension officers.
- Homestead plot utilization would be effective for households with plot of at least (critical size) 240 m^2 (with open space of at least 140 m^2)
- Promote the use of ecologically-adaptive farming systems with promising species of plant, livestock and fish. For example: fishery, *longyam* (combination of raising chicken upon fish pond), *longan*, *mangosteen*, gnetum (*melinjo*) and nutmeg (West Java); salak palm (Central Java) and maize (East Java). Generic plants for the three provinces are coconut, guava, mango, papaya, banana, rambutan, chili and cassava. Generic livestock recommended are chicken and goat. For

specific location, particularly in highlands with good water availability, it is recommended to raise cow (for meat or milk production).

- Promote involvement of women in the management and decisions associated with agricultural production activities.
- Select households that involve agricultural-based land uses and that are highly motivated to use the land productively
- Select households that meet the four *general* criteria developed by BPN:
    a) Living in the administrative sub-district
    b) Indonesian nationality
    c) Are poor
    d) Are ≥ 18 years old
- Select households that meet the five *specific* criteria developed by BPN, including
    a) Landless status
    b) Duration of residence
    c) Relevant job experience
    d) Highly motivation to utilize the land
    e) Asset ownership ≤ 15 million rupiahs (For comparison, maximum total of asset values [excluding land and building] obtained in the survey was 9.3 million rupiahs).
- The homestead plot design should accommodate homestead property rights, including fencing and capital improvements, and facilitate social interaction
- Promote development near existing villages with good physical and service infrastructure.
- Credit should be provided (a) to increase land productivity, (b) to reflect land suitability and community development feasibility (c) without using critical family assets such as land and house as collateral (d) to promote communal initiatives and cooperatives, and (e) prudently administered, using clearly-defined, objective and transparent criteria.

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