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SUSTAINABLE AGRICULTURE PRODUCTION,
AND ECONOMIC COMMUNITIES

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Constraints to, challenges, and opportunities for rearing goats in Bali Province.
A case study: rearing goats in Banjar Belulang, Sepang Village

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Abstract
The purpose of this study was to establish a database identifying the constraints to, challenges of and opportunities for rearing goats in Bali Province. Questionnaire surveys and measurement of the biological and productivity parameters of goats were conducted to determine the profiles of goats and farmers in Banjar Belulang, Buleleng Regency in September 2013. Thirteen of 57 goat owning families, and 117 from a total of 459 goats in Banjar Belulang were systematically sampled. Integrated farming of coffee and goats has been practiced for a long time by the farmers in this Banjar and there were 7 Small (5 – 10), 4 Medium (11 – 20) and 2 Large (> 20) flocks of goats. Goats were penned in coffee plantations and fed Gamal (Gliricidia sepium), Kaliandra (Caliandra calothyrsus), King grass (Pennisetum purpureum) and Jackfruit (Artocarpus heterophyllus). The farmer with the largest flock milked their goats and sold whole milk and other milk products. Training in goat management and providing calendars for data recording are recommended so that farmers are able to increase goat production.

Keywords: goats, Bali, database, questionnaire, parameters

1. Introduction
Goats are a livestock species that can be used to alleviate poverty and supply animal protein to alleviate human malnutrition. Knowledge of the biology and the parameters of productivity and reproduction of goats are important for improving their production. Recording parameters of productivity e.g. liveweight of goats requires time and is worthwhile as farmers who regularly weigh their goats usually pay more attention to their health, breeding and growth rates, and thus the productivity of their goats. Although knowing the liveweight of goats is valuable this is often difficult to achieve as scales are costly and to overcome this calibrated tape measures can be used to estimate the liveweight of livestock.

There is currently very little information about measures of productivity and reproduction of goats or goat rearing systems in Bali and as such there are no clear target goals for the future of the goat industry in Bali. Thus it is essential to conduct a baseline study of goat production by smallholder farmers in Bali. To start this process a case study of goat farmers and their goats in Banjar Belulang was undertaken where a subsample of smallholder goat farmers where interviewed about their goats and measurements recorded from their goats. In addition, other factors influencing goat production in in Banjar Belulang were also assessed.

2. Materials and methods
The questionnaires consisted of two parts with the first questions about the goat farmer e.g. their age, gender, education, sources of income and then questions were about the goats e.g. the number of goats, flock composition, breeding history and feeding systems. Thirteen of the total 57
household families in Banjar Belulang were systematically sampled in early September 2013 and these families owned 117 of the 459 goats in the Banjar. Data was collected on the goats owned by the farmers that completed the questionnaires and this included measurements of the goats age (from teeth), sex, body weight (kg), body length (cm), chest circumference (cm), chest depth (cm), height at wither (cm) and rump height (cm). These measurements will be used to produce a calibrated tape measure to estimate liveweight of goats.

3. Results and discussion
3.1 Animal ownership and flock composition
Average flock size in Banjar Belulang was 15 goats ranging from 5 to 54 goats. There were 7 Small (5 – 10), 4 Medium (11 – 20) and 2 Large (> 20) flocks of goats. It was useful to classify the size of the flock owned by farmers as this is relevant to the rearing management practices used as well as future management plans. This information can be used to identify successful feeding and rearing systems and thus influence the capability of farmers to increase their flock size in the future. For example the farmer who had the largest flock size was able to milk their goats and sell whole milk and produce milk products. More investigation is needed to understand the success of their production system.

3.2 Feeding systems
Banjar Belulang smallholder farmers grow coffee which is intercropped with goat’s feed including Gamal (*Gliricidia sepium*), Kaliandra (*Caliandra calothyrsus*), King grass (*Pennisetum purpureum*) and Jackfruit (*Artocarpus heterophyllus*). The quality and quantity of feeds given to goats is based on their requirements but at times this was not met, particularly in the dry season. This situation was more serious for big flocks when goat farmers only have a small coffee plantation. The farmers of these flocks were unable to access feed and buying concentrate is uncommon. Fermenting coffee fruit skins could provide additional feed for goats. Samblung leaves are commonly fed to does just weaned from their kids as farmers believe that feeding Samblung leaves can stimulate does into oestrus. More investigation is required to determine feeds available to meet the needs of goats and the secondary compounds contained in Samblung leaves.

3.3 Breeds and breeding systems
Smallholder farmers in Banjar Belulang rear Etawah, Kacang, Peranakan Etawah and Benggala goats, and their crossbreds. The farmers with small flocks usually did not have bucks or the bucks were too young for mating. Therefore, borrowing bucks from other farmers is common. As goats were penned in coffee plantations, that were a distance from the farmers’ home, observing does’ in oestrus was difficult and often resulted in oestrus being missed. Thus kidding intervals became longer. Furthermore farmers do not keep records and as such breeding is unplanned. Therefore it is recommended that farmers keep records in order to enable them to plan, and to evaluate their goat breeding, to improve goat production in Banjar Belulang.

3.4 Measurement of goats
There is an opportunity to develop equations correlating live weight and linear measurements for goats in Banjar Belulang. These linear dimensions can be used to estimate live weight as shown in Table 1. The correlation between rump height and live weight both in male kids (0.94) and goats
(0.95) in Banjar Belulang has the highest $r^2$ value whilst the lowest value of $r^2$ (0.70) was found in the correlation between chest depth and body weight in male goats. Correlations between the chest circumference and body weight or chest depth with body weight had $r^2$ values higher in younger kids than in older goats; whereas the correlations for body weight to the body length, height at wither or the rump height in older goats had higher $r^2$ values.

Table 1. Values of $r^2$ for BL/BW; CC/BW; CD/BW; HW/BW; and RH/BW of goats reared in Banjar Belulang, Sepang Village

<table>
<thead>
<tr>
<th>Measures</th>
<th>$I_0♀$ kids</th>
<th>$I_0♂$ kids</th>
<th>All $I_0$ kids</th>
<th>Females</th>
<th>Males</th>
<th>All goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL/BW</td>
<td>0.89</td>
<td>0.72</td>
<td>0.80</td>
<td>0.89</td>
<td>0.79</td>
<td>0.84</td>
</tr>
<tr>
<td>CC/BW</td>
<td>0.84</td>
<td>0.94</td>
<td>0.86</td>
<td>0.91</td>
<td>0.71</td>
<td>0.83</td>
</tr>
<tr>
<td>CD/BW</td>
<td>0.85</td>
<td>0.91</td>
<td>0.86</td>
<td>0.91</td>
<td>0.70</td>
<td>0.80</td>
</tr>
<tr>
<td>HW/BW</td>
<td>0.89</td>
<td>0.92</td>
<td>0.90</td>
<td>0.92</td>
<td>0.95</td>
<td>0.93</td>
</tr>
<tr>
<td>RH/BW</td>
<td>0.78</td>
<td>0.94</td>
<td>0.87</td>
<td>0.90</td>
<td>0.95</td>
<td>0.92</td>
</tr>
</tbody>
</table>

BW (body weight); BL (body length); CC (chest circumference); CD (chest depth); HW (height at wither) and RH (rump height). $I_0$ = no adult Incisors (<1 year).

A constraint faced during this preliminary research was that the local farmers who assisted with goat measurements were not strong enough to weigh the mature does and bucks. As a result, heavier does and bucks were not weighed. Therefore, the $r^2$ values for mature does and bucks may have been lower because of small sample size. In the future, other personnel who can provide the required assistance will be employed in order to obtain better measurements of all goats including the mature does and bucks.

4. Conclusions
Guidance in goat management and providing Balinese calendars are recommended so that farmers can more easily record the parameters of goat productivity as their daily activities included goat rearing related to their belief. Methods of easily and cheaply estimating liveweight need to be made available so farmers can easily weigh their goats at critical times such as at birth, weaning, first maturity, first and subsequent matings, and when goats are sold. In the future, this study is expected to develop reliable equations correlating live weight and linear measurements for goats in Banjar Belulang. These can then be used to estimate the live weight of goats in Bali province, including in Banjar Belulang, to improve their management.