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SHRUBS AND TREE FODDERS OR FARM ANIMALS

PROCEEDINGS OF A WORKSHOP IN DENPASAR, INDONESIA, 24 - 29 JULY 1989



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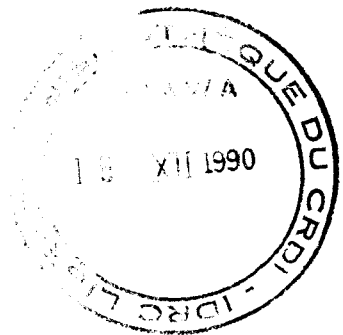
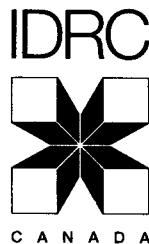
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Shrubs and tree fodders for farm animals

Proceedings of a workshop in Denpasar, Indonesia,
24-29 July 1989

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Abstract

This publication presents the results of an international meeting held in Denpasar, Bali, Indonesia, 24–29 July 1989, that focused on the use of shrubs and tree fodders by farm animals. Through 26 papers, the workshop addressed feed-resource availability, use by ruminants and nonruminants, processing methodology, economics, and development issues. These aspects and the current knowledge on shrubs and tree fodders were further highlighted by country case studies detailing prevailing situations and policy matters. A special session was held to discuss the successful development and results achieved in the three-strata forage system in Indonesia. The workshop concluded with important working group discussions on the priorities for further research and development, and on the potential for the wider use of shrubs and tree fodders in the developing world.

Résumé

Cette publication présente les résultats d'une rencontre internationale tenue à Denpasar, Bali, Indonésie, du 24 au 29 juillet 1989 et qui a porté sur l'utilisation des arbustes et fourrages végétaux par les animaux d'élevage. Les 26 communications qui y ont été présentées traitaient de la disponibilité des ressources alimentaires pour les animaux, de leur utilisation par les ruminants et les non-ruminants, des méthodes de transformation, des aspects économiques et des questions du développement. Ces sujets et les connaissances actuelles sur les arbustes et les fourrages végétaux ont ensuite été étudiés plus à fond dans le cadre d'études de cas de divers pays exposant les circonstances particulières de chacun et les questions liées aux politiques. Une séance spéciale a porté sur la mise en place et les résultats des systèmes de production de fourrages végétaux en trois strates en Indonésie. L'atelier s'est terminé par d'importantes discussions des groupes de travail sur les priorités de recherche et de développement pour l'avenir et sur les possibilités d'utilisation élargie des arbustes et des fourrages végétaux dans les pays en développement.

Resumen

Esta publicación presenta los resultados de una reunión internacional celebrada en Denpasar, Bali, Indonesia, del 24 al 29 de julio de 1989, y la cual centró su atención en la utilización de forrajes elaborados a partir de arbustos y árboles para alimentar a animales de granjas. En 26 trabajos presentados al seminario, los participantes abordaron temas tales como la disponibilidad de recursos alimentarios y la utilización de los mismos por rumiantes y no rumiantes, metodologías de procesamiento y cuestiones de economía y desarrollo. Estos aspectos y el conocimiento que se tiene actualmente sobre los forrajes de arbustos y árboles se vieron subrayados aún más por estudios de casos por países en los que se detallaron situaciones existentes y cuestiones de políticas. Se celebró una sesión especial para discutir el desarrollo y resultados exitosos alcanzados en Indonesia con el sistema de forraje de tres niveles. El taller concluyó con importantes discusiones de los grupos de trabajo sobre las prioridades existentes en el campo de la investigación y el desarrollo y sobre el potencial que encierra la amplia utilización de arbustos y árboles en el mundo en desarrollo.

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Socioeconomic aspects of the three-strata forage system in Bali

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Abstract — During the wet season, farm income formed 24.8, 30.2, and 62.1% of total income for the three-strata forage system (TSFS), the non-three-strata forage system (NTFS), and the traditional system (TRDS), respectively. Corresponding values in the dry season were 82.2, 81.2, and 78.1%. The average gross margin per year was 786.50, 504.30, and 351.30 United States dollars (USD), and the contribution of livestock to gross farm income as percentage of total income was 33.8, 28.9, and 35.7% for TSFS, NTFS, and TRDS, respectively. In the wet season, each TSFS plot produced 24.80 USD compared with 20.40 USD for NTFS. In the dry season, each TSFS plot produced 155.90 USD compared with 141.80 USD for NTFS. TSFS plots generated 18.50 USD more than NTFS (74.00 USD/ha) annually.

Résumé — Durant la saison humide les revenus de l'exploitation agricole ont formé 24,8, 30,2 et 62,1 % du revenu total du régime à trois espèces fourragères (RTEF), du régime sans trois espèces fourragères (RSTEF) et du régime traditionnel (RT), respectivement. Les chiffres correspondants pour la saison sèche ont été 82,2, 81,2 et 78,1 %. La marge brute moyenne par année a été de 786,50, 504,30 et 351,30 en dollars des É.-U. (USD). Quant à la contribution du bétail au revenu brut de l'exploitation agricole, exprimée en pourcentage du revenu total, elle a été de 33,8, 28,9 et 35,7 % pour le RTEF, le RSTEF et le RT, respectivement. Durant la saison humide, chaque parcelle RTEF a produit 24,80 USD comparativement à 20,40 USD pour la parcelle RSTEF. Durant la saison sèche, chaque parcelle RTEF a produit 155,90 USD en comparaison de 141,80 USD pour la parcelle RSTEF. Les parcelles RTEF ont produit 18,50 USD de plus que les parcelles RSTEF (74 USD/ha) par année.

Resumen — Durante la estación de lluvias, la renta de la explotación agrícola constituyó el 24,8, 30,2, y el 62,1 por ciento de la renta total para el sistema de forraje en tres capas (TSFS), el sistema forrajero diferente del anterior (NTFS) y el sistema tradicional (TRDS), respectivamente. Los valores correspondientes en la estación de sequía fueron 82,2, 81,2, y 78,1 por ciento. El margen bruto promedio por año fue 786,50, 504,30 y 351,30 dólares estadounidenses (USD), y la contribución de la ganadería a la renta bruta de la explotación agrícola como porcentaje de la renta total fue del 33,8, 28,9 y 35,7 por ciento para el TSFS, NTFS y TRDS, respectivamente. En la estación de lluvias, cada parcela del TSFS produjo 24,80 USD comparado con 20,40 USD para el NTFS. En la estación de sequía, cada parcela del TSFS produjo 155,90 USD comparado con 141,80 USD para NTFS. Anualmente, las parcelas del TSFS produjeron 18,50 USD más que NTFS (74,00 USD/ha).

Introduction

Most farmers in Bali are traditional smallholders. Their main activity is growing food crops; livestock production is a sideline activity. As a result, the income from livestock is only 29–43% of the net farm income (Putra and Arga 1979). In dryland farming areas, the contribution of livestock to farm income tends to be higher than in wet farming areas.

The concept and development of the three-strata forage system (TSFS) has been described by Nitis et al. (this volume) and its design and methodology by Lana et al. (this volume). A study on economics showed that the net farm incomes of TSFS, non-three-strata forage system (NTFS), and traditional system (TRDS) farmers were about 1 204 000, 888 000, and 355 000 IDR, respectively (Nitis 1986) (in July 1989, 1 700 Indonesian rupiah [IDR] = 1 United States dollar [USD]). It was also found that the contribution of livestock to total farm income was 41.5, 33.8, and 49.9% for TSFS, NTFS, and TRDS farmers, respectively.

As a follow-up, it was proposed to examine in more detail other economic aspects. The objectives of this study were

- to evaluate the farmer's and farm's income during dry and wet seasons for TSFS, NTFS, and TRDS,
- to evaluate the income per experimental plot of TSFS and NTFS farmers' groups during the wet and dry seasons, and
- to compare whole farm income per hectare and income per hectare from the TSFS experimental plots and from NTFS plots. This paper presents the results of this study.

Materials and methods

Farmer sample

Using a prepared questionnaire, researchers interviewed 39 farmers (12 TSFS, 14 NTFS, and 13 TRDS) about their economic activities. A monthly farm survey was also carried out using a simpler questionnaire.

TSFS farmers have their own farm and plots within the farm. NTFS farmers have their own farm but not a three-strata forage system. Traditional farmers (TRDS) have their own farm but neither TSFS nor NTFS plots.

Methods of analysis

Average gross farm income, gross margin, gross margin per hectare, gross margin of the experimental plots (TSFS and NTFS), and cost structure for the three groups of farmers were determined by farm accounting methods. The income flow was divided into two groups: wet and dry seasons.

Results

Farming system

The TSFS project is located in Bukit Pecatu village in Bali. It ranges from the coast (sea level) to a hilly area, 150 m above sea level. The area is 30% flat and 70% undulating. The soil is red-brown mediterranean, with a calcareous limestone base. In this area, farmers make up 80% of the population, with landholdings varying from 0.5 to 2.5 ha. The cash crops most commonly grown are corn, soybean, and cassava, and the main fruit crops are mangoes, sugar apples, and oranges. In 1988, the orange crop was destroyed by citrus vein phloem disease (CVPD). Other perennial crops that have been grown by farmers, especially after the "greening campaign" of the government, are kapok and cashew nut. The local important fibre plant is screw pine (*Pandanus* spp.). It is used in mat making. Firewood is also locally important, contributing to monthly income and providing a source of energy.

The ruminants reared are cattle and goats. Cattle are fed grasses and crop residues during the wet season and shrubs and tree leaves during the dry season. Male cattle are preferred over female cattle. Pigs and poultry are also important in supplementing the farmer's income.

Educational level of farmers

Out of the 245 farmers, 85 were illiterate (34.7%); 23 of these were male and 62 were female. Among males, 17.3% had attended junior high school, 13.5% had attended senior high school, and 2.3% had gone to university. Among women, corresponding values were 8.0, 7.1, and 0% (Table 1). For adult males above 30 years (45.9% of total), 65.6% finished elementary school and 34.4% were illiterate; for women, 85% were illiterate and only 15% finished elementary school. Within the 10–30 year age group, 33.3% of females were uneducated compared with only 7.7% of males.

Land use

The farmers used their land to grow grasses for the cattle and for annual cropping (corn, soybean, and cassava). Sloping land was used for grasses and flat land was used for annual crops. The farmers believe that if they grow annual crops on sloping land, the crop will fail. On the borders of the fields, farmers grew fences dominated by cactus, wild shrubs, and trees. The trees and shrubs supply green feeds for the cattle. For the annual crop, all the farmers practiced simultaneous planting to make the most efficient use of the rainwater supply. They planted the cassava, corn, and soybean within rows. The distance between two rows of cassava and corn was 1 m; for soybean, 25 cm. The distance between a cassava row and the nearest corn row was 50 cm. Soybean was planted between rows of cassava and corn.

The average landholdings were 3.8, 3.7, and 2.3 ha for TSFS, NTFS, and TRDS farmers, respectively. The average grass fields were 2.9, 2.1, and 1.4 ha and annual

Table 1. Education level of the adult members (10 years and above) of the 39 farming families.

Level of schooling	Males				Females			
	TSFS	NTFS	TRDS	% of total	TSFS	NTFS	TRDS	% of total
None	11	6	6	17.3	25	20	17	55.4
Elementary	23	20	23	49.6	12	8	13	29.5
Junior high school	13	8	2	17.3	4	2	3	8.0
Senior high school	10	5	3	13.5	4	4	0	7.1
University	1	2	0	2.3	0	0	0	0.0
Total	58	41	34		45	34	33	

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

Table 2. Farm characteristics.

	TSFS	NTFS	TRDS
Average landholding (ha)	3.8	3.7	2.3
Grassing field (ha)	2.9	2.1	1.4
Annual cropping (ha)	0.9	1.6	0.9
Cropland under ownership (%)	100	100	100
Livestock ownership (head/farm)			
Cattle	9	8	6
Pigs	3	1	1
Goats	1	—	—
Chickens	51	47	25
Gross farm income (USD/year)	1 123.6	785.3	660.5

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

cropping fields were 0.9, 1.6, and 0.9 ha for TSFS, NTFS, and TRDS farmers, respectively (Table 2). All of the 39 farmers, held ownership tenancy.

The most important livestock was cattle (Table 2), mainly used for draft, breeding, and fattening. They were also raised for security (as an investment), as collateral for production loans, and as a form of savings.

Pigs are raised for fattening. The income from rearing pigs is used to provide cash to meet the immediate needs of the household and for the “adat” ceremony. Chickens are also used to provide family income and “adat” ceremony.

Income sources

Farming is the main occupation of the farmers. Limestone quarrying, small-scale trading, harbour and airport labour, construction work, and carpentry are other sources of income for men. Women earn extra income by plaiting mats, waiting on tables, and in small-scale trading, pig raising, and shop keeping.

The average farm income in the wet season for TSFS and NTFS was less than the average nonfarm income (Table 3). For the traditional systems, however, farm income is higher than nonfarm income in the wet season. In the dry season, farm income is always higher than nonfarm income. The gross average incomes in the wet season for TSFS, NTFS, and TRDS were 120.20, 111.10, and 151.00 USD, respectively. Corresponding values for the dry season were 1 329.40, 926.00, and 725.40 USD. The average gross farm income was 823.30 USD/year: 52.50 USD (6.2%) in the wet season and 785.80 USD (93.8%) in the dry season (Table 4).

Average gross farm income was 14.53 USD/ha (24.7×10^3 IDR/ha) in the wet season and 236.06 USD/ha (401.3×10^3 IDR/ha) in the dry season, for a total of 250 USD/ha over the year. The average incomes in wet season were 7.70, 9.00, and 34.53 USD and, in the dry season, 284.47, 202.35, and 188.24 USD, for TSFS, NTFS, and TRDS, respectively (Table 5).

Cash costs and gross margin

Average total farm expenses per year were 529.5×10^3 IDR, of which 98.0% was spent in the wet season (Table 6). This is because most of the farm activities

Table 3. Average gross income (IDR $\times 10^3$).^a

	Wet season			Dry season		
	TSFS	NTFS	TRDS	TSFS	NTFS	TRDS
Farm income						
Cash crop	29.7	34.8	25.2	1 176.9	856.5	653.8
Livestock	—	—	120.0	646.2	386.0	280.7
Manure	7.6	5.6	4.9	11.9	8.1	1.5
Firewood	13.4	16.7	9.4	24.4	27.4	27.2
Total	50.7	57.1	159.5	1 859.4	1 278.0	963.2
	(24.8) ^b	(30.2)	(62.1)	(82.2)	(81.1)	(78.1)
Nonfarm income						
Limestone quarrying	93.7	26.7	41.1	158.3	58.5	114.2
Mat plaiting	4.6	3.9	18.3	12.2	34.7	31.4
Small-scale trade	—	86.7	5.0	1.4	133.6	21.1
Carpentry	2.5	—	16.1	4.8	3.5	29.2
Hired labour	9.8	14.2	12.6	10.5	29.5	36.1
Other jobs	42.9	—	3.8	213.3	36.0	37.6
Total	153.5	131.5	96.9	400.5	295.8	270.3
	(75.2)	(69.8)	(41.8)	(17.8)	(18.9)	(22.9)
Farmer average	204.2	188.6	256.4	2 259.9	1 573.8	1 233.5
Gross income (USD) ^b	120.2	111.1	151.0	1 329.4	926.0	725.4

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

Source: Nitris et al. (1988b).

^a In July 1989, 1 700 Indonesian rupiah (IDR) = 1 United States dollar (USD).

^b Values in parentheses are percentages of the total income.

Table 4. Average gross farm income during the wet and dry seasons (IDR $\times 10^3$ /farm).^a

	Wet season				Dry season			
	TSFS	NTFS	TRDS	All farms	TSFS	NTFS	TRDS	All farms
Cash crops								
Corn	13.5	12.4	11.6	12.5	—	—	—	—
Soybean	—	—	—	—	407.3	434.7	259.8	368.0
Cassava	—	—	—	—	270.1	130.6	19.9	136.6
Other beans	—	—	—	—	27.8	35.4	58.2	40.6
Sugar apple	15.8	22.4	13.6	17.4	—	—	—	—
Coconut	—	—	—	—	20.1	9.2	2.6	10.4
Kapok	—	—	—	—	392.9	233.2	297.6	203.8
Cattle								
Cattle sold	—	—	105.0	35.0	525.9	303.5	226.5	346.2
Pigs								
Pigs sold	—	—	15.0	5.0	83.6	50.5	25.7	36.1
Poultry								
Chickens sold	—	—	—	—	36.7	31.8	28.5	32.2
Others								
Farm yard manure	7.8	5.5	4.7	5.9	11.7	8.2	7.1	8.9
Firewood	13.4	16.7	9.4	13.3	24.4	27.2	21.5	24.4
Average farm income ^b	50.7 (29.8)	57.1 (33.6)	159.5 (93.8)	89.2 (52.5)	1 859.4 (1 093.7)	1 278.0 (751.8)	963.3 (566.7)	1 335.9 (785.8)

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

^a In July 1989, 1 700 Indonesian rupiah (IDR) = 1 United States dollar (USD).

^b Values in parentheses are in US dollars.

Table 5. Average gross farm income (IDR $\times 10^3$ /ha).^a

	Wet season				Dry season			
	TSFS	NTFS	TRDS	All farms	TSFS	NTFS	TRDS	All farms
Cash crop	7.6	9.3	10.9	9.1	306.0	230.5	283.5	270.2
Livestock	—	—	52.1	12.1	168.0	103.9	121.0	131.2
Cattle manure and firewood	5.5	5.9	6.1	5.8	9.4	9.5	12.4	10.1
Subtotal (season) ^b	13.1 (7.7)	15.3 (9.0)	58.7 (34.5)	24.7 (14.5)	483.6 (284.5)	344.0 (202.4)	320.0 (188.2)	401.3 (236.1)
Total (both seasons) ^b	496.7 (291.2)	359.3 (211.4)	378.7 (222.8)	426.0 (250.0)				

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

^a In July 1989, 1 700 Indonesian rupiah (IDR) = 1 United States dollar (USD).

^b Values in parentheses are in US dollars.

Table 6. Cash costs during the wet and dry seasons (IDR $\times 10^3$ /ha).^a

	Wet season				Dry season			
	TSFS	NTFS	TRDS	All farms	TSFS	NTFS	TRDS	All farms
Cash crops	157.6	106.9	132.5	136.4	—	—	—	—
Seeds (soybean and corn)	32.5	22.1	31.7	30.0	—	—	—	—
Cutting (cassava)	11.1	4.6	7.4	8.9	—	—	—	—
Land preparation	63.9	39.8	51.4	53.6	—	—	—	—
Weeding	50.0	40.0	42.0	43.7	—	—	—	—
Cattle	388.4	345.5	369.2	367.7	11.9	11.2	7.6	10.2
Cattle (2-3 years old)	382.5	340.0	365.5	362.6	—	—	—	—
Cattle shed	2.7	2.4	—	1.7	5.6	4.9	—	3.5
Rope	0.6	0.6	1.3	0.8	1.3	1.3	2.6	1.7
Sickles	0.8	0.8	0.8	0.8	1.6	1.6	1.6	1.6
Medication	0.6	0.6	0.6	0.6	1.3	1.3	1.3	1.3
Baskets	0.9	0.9	0.9	0.9	2.0	2.0	2.0	2.0
Pigs								
Piglets	15.0	14.0	16.0	14.9	—	—	—	—
Total cost (season)	561.0	466.4	517.8	519.2	11.9	11.2	7.6	10.2
Total cost (both seasons)	572.9	477.7	525.5	529.5				

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

Source: Nitis et al. (1988b).

^a In July 1989, 1 700 Indonesian rupiah (IDR) = 1 United States dollar (USD).

Table 7. Gross margin per lot (IDR $\times 10^3$).^a

	Wet season		Dry season		Both seasons	
	TSFS	NTFS	TSFS	NTFS	TSFS	NTFS
Corn ^b	3.9	4.1	—	—	3.9	4.1
Soybean	—	—	119.2	144.6	119.2	144.6
Cassava	—	—	79.0	43.4	79.0	43.4
Cattle	28.2	22.9	42.1	34.1	70.3	57.1
Feed						
Corn straw	2.6	5.4	—	—	2.6	5.4
Soybean straw	—	—	7.2	11.2	7.2	11.2
Cassava straw	—	—	5.0	7.6	5.0	7.6
Grasses (cenchrus and panicum)	6.0	—	—	—	6.0	—
Legumes (urochloa, verano, and centrosema)	1.3	—	—	—	1.3	—
Shrubs (gliricidia and leucaena)	—	—	5.0	—	5.0	—
Trees (ficus, lannea, and hibiscus)	—	—	0.3	—	0.3	—
Native grass	—	2.2	—	—	—	2.2
Firewood (gliricidia and leucaena)	—	—	6.9	—	6.9	—
Total ^c	42.0 (24.8)	34.6 (20.4)	264.7 (155.9)	240.9 (141.8)	306.7 (180.4)	275.6 (162.1)

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

Source: Nitis et al. (1988b).

^a In July 1989, 1 700 Indonesian rupiah (IDR) = 1 United States dollar (USD).

^b The corn crop failed in 1987, 1988, and the first half of 1989.

^c Values in parentheses are in US dollars.

Table 8. Time spent on keeping cattle (min/head per year).

Activity	TSFS	NTFS	TRDS
Feed collection	58	61	77
Feeding	19	20	70
Watering	17	18	24
Watching	21	38	60
Total time	115	137	178

Note: TSFS, three-strata forage system; NTFS, non-three-strata forage system; TRDS, traditional forage system.

Source: Nitis et al. (1988a).

are carried out in the wet season. The expenses in the wet season included 26.3% for cash crop and 70.8% for cattle activities.

The average gross margins per year were $1\,337 \times 10^3$, 857×10^3 , and 597×10^3 IDR for TSFS, NTFS, and TRDS, respectively. For all farms, the average gross margin was 918×10^3 IDR.

The benefit of TSFS plots

In terms of gross margin per year, the benefit of the TSFS plots was 306.7×10^3 IDR (180.40 USD) compared with 275.6×10^3 IDR (162.12 USD) for NTFS (Table 7). Average gross margin per hectare per year was 723.20 USD for TSFS and 649.20 USD for NTFS; therefore, each hectare of TSFS produced 74.00 USD more than each hectare of NTFS.

Other benefits of TSFS plots included time saved in feed collection: TSFS plots were always prepared, close by, and had more feeds than NTFS plots. TSFS farmers spend 22 min less per day than NTFS, or 63 min less than traditional farmers, on keeping one cow (Nitis et al. 1988a) (Table 8).

At current prices and given the available technology, the gross margin of the plots is affected by the slope of the land, rainfall distribution, the age of the trees that surround the plots, and the total weight gain of the cattle kept in the plots. Sloping land will produce less cash crops than flat land. Rainfall is unpredictable. Firewood and forage production depend on the age of the trees around the plots. The older the tree, the more firewood and forage will be produced, and the greater the contribution to total income. Cumulative weight of cattle kept in the plots always increases to the maximum. Hence, the gross margin of profits from cattle rearing will also increase.

There are some other unaccountable benefits of TSFS. These include increased land fertility, decreased erosion, rearing honey bees, and support for the government's greening program (Nitis et al. 1988b).

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