Transformation of Traditional Silvo-pastoral Home-gardens through Pasture Development Program: A Case Study in Southern Sri Lanka

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Background
Pasture Development Program in Matara district commenced in 2012 with the aim of:

- Increasing milk production and
- Income of small-scale dairy farmers
- Through continuous supply of sufficient quality feed

The 4 year program:

- Selected 100 farmers from 37 Veterinary Surgeons Ranges
- Rearing more than 2 cattle
- Can grow more than 200 bushes of fodder
- Covering more than 10 perches (1 perch = 25.3m²) land in home-gardens
Traditional home-garden:
- With trees and shrubs, annual and perennial crops, and livestock
- Provides ecosystem services, household needs and part of livelihood strategy

Each participant was given:
- Rs. 5,000 as a grant
- Information leaflets, training, and CO3 fodder planting materials
- Hybrid Napier (Var. CO-3):
  - Fresh yields 5-8 kg / plant:
  - 45 day cutting interval and 1 x 1 m spacing
Objectives
Objectives of the study were:

- To examine the ecosystem changes
- To analyze the economic trade-offs and
  - To ascertain the social breakthroughs
- As impacts of the pasture development program
- Further make policy implications to popularize and replicate the program
Methodology
Questionnaire survey:
- Interviewing 34 farmers randomly selected from 100 participants
- Using Likert Scale: Very High – 5; High – 4; Moderate – 3; Low – 2; Very Low – 1; No – 0
- Discussed with key resource personnel of the program
- Field observations

Analysis:
- Descriptive statistics
- Z- Wilcoxon Signed Ranks Test
- MH St.-Marginal Homogeneity Test
- $\gamma$- Pearson Correlation
Results and Discussion
Milk Farmers Participating in Pasture Development Program
- **Middle age** (mean 47 and median 43 years)
- **Upper secondary education** (mean 13\textsuperscript{th} and median 10\textsuperscript{th} Grade)
- **Have small size families** (mean 3 and median 3)
- **Wide range in sizes of home-gardens from 40 to 320 perches** (mean 128.7 and median 95 perches)
- **Only 29% are full-time farmers in occupation**
- **Others (71%) are part-time farmers**
Ecosystem Changes in Silvopastoral System of the Home-Gardens after the Pasture Development Program
Composition of Cows

- Traditional composition of cows has not been changed
- Usually rearing Jersey, Persian, Syhivahal-cross and Syhivahal and Batu (indigenous) breeds
- Average number of cows increased from 3 (Min-2; Max-5; SD-0.937) to 4 (Min-2; Max-8; SD-1.472).
- Number of cows has been increased in 39% significantly (Z=4.073; and P=0.000)
Vegetation of Eco-system

- Significant reductions of the coverage of:
  - Traditional grass/fodder in 66% ($Z=-4.815$; and $P=0.000$);
  - Annual Crops in 18% ($Z=-2.415$; and $P=0.016$);
  - Perennial Crops in 24% ($Z=-4.617$; and $P=0.000$);
  - Forest Trees in 05% ($Z=-3.207$; and $P=0.001$); and
  - Other Vegetation in 28% ($Z=-3.066$; and $P=0.002$)
Traditional and CO3 Fodder Cultivation

- Average traditional grass/fodder reduced from 26 perches (21%) to 9 perches (7%)
- CO3 fodder cultivated in average 18 perches (16%) (minimum - 10; maximum - 40)
- Significant positive correlation ($\gamma=0.545; P=0.001$) between land used for CO3 and size of home-gardens
- Lands under coconut and forest tress use for CO3
Knowledge on Ecosystem Management

- Farmers trained on CO3 cultivation in home-gardens

- Knowledge on land use planning significantly changed (MH St. = 4.379; and P = 0.000):
  - From "Low" (mean - 2.2; minimum-1; maximum-3; SD-0.592 and median - 2) to "Moderate" (mean - 2.8; minimum-2; maximum-4; SD-0.717 and median - 3)

- Knowledge on selecting cropping systems significantly changed (MH St. = 4.747; and P = 0.000)
  - From "Very Low" (median - 1) to "Low" (median - 2)
Improvement of Economic Trade-offs after the Pasture Development Program
Milk Yield and Household Consumption

- Average production of milk /cow /day has increased by 90% significantly (Z=5.169 and P=0.000) from 3.1 to 5.9 liters

- Average amount of milk production /day /farmer has increased by 164% significantly (Z=5.169 and P=0.000) from 9.6 to 25.2 liters

- Increasing household consumption by 28% significantly (Z=2.342 and P=0.020) from 0.9 to 1.1 liters
Market Surplus and Income

- Average milk sold /day/farmer increased in 177% significantly (Z=5.090 and P=0.000) from 8.7 to 24.1 Ls

- Average income /farmer has increased by 291% significantly (Z=5.086 and P=0.000) from Rs. 417 to 1,629/day

- Increased price of milk by 42% significantly (Z=5.093 and P=0.000) from average Rs. 46.97 to 66.82 /L

- Part-time farmers (71%) consider this income as an extra earning

- Full-time farmers (29%) as an additional domestic activity with wife and family members
Production of Fodder and Feeding Cows

- Average amount of fodder production increased by 117% significantly \((Z=4.991 \text{ and } P=0.000)\) from 2.7 to 5.9 kg /cow/day

- Average 5.73 kg of CO3 /cow /day with minimum 2 kg to maximum 12.5 kg \((SD=2.443)\)

- Produce average 58.07 kg \((\text{minimum 22.50; maximum 112.5; SD=14.747})\) of CO3 /perch in 45 days harvesting cycle

- Reduce feeding cows with other feeds:
  - Rice straw and rice brand by 52% significantly \((Z=-4.757 \text{ and } P=0.000)\) from 1.9 to 0.9 kg/cow/day
Duration of Feeding Cows

- Average feeding duration at private lands decreased in 226% significantly \((Z=-5.068 \text{ and } P=0.000)\) from 4.3 to 2.0 hours /day

- Average duration of feeding at village common land also reduced in 66% significantly \((Z=-4.565 \text{ and } P=0.000)\) from 2.1 to 0.7 hours per day

- Average total duration of feeding cows reduced in 11% significantly \((Z=-4.647 \text{ and } P=0.000)\) from 9.6 to 8.6 hours/day
Contribution of House-hold Vegetable and Fruits from Home-gardens

- Farmers (79%) produced average 20% (minimum 0; maximum 40; SD-13.285) of vegetables requirement before pasture program.

- After pasture program, 68% farmers reduced vegetable contribution in 40% significantly (Z=-4.231 and P=0.000) to 12.1% (minimum 0; maximum 30; SD-10.381).

- Farmers (100%) produced average 57.4% (minimum 10; maximum 90; SD-17.111) fruits requirement before the program.

- Contribution of fruit requirement of 97% of farmers reduced by 38% significantly (Z=-5.098 and P=0.000) to 35.4% (minimum 0; maximum 80; SD-17.511) after the program.
Contribution of House-hold Firewood and Wood from Home-gardens

- Farmers (100) fulfill 100% fire-wood requirement from home-gardens even after the pasture program

- Very little (01%) reduction of wood requirement of 97% farmers from 63.5% (minimum 0; maximum 95; SD-19.288) to 62.8% (minimum 0; maximum 95; SD-19.196) after the program

- Which is not statistically significant
Development of Social Breakthroughs by the Pasture Development Program
Damages Caused By Cows to Agricultural Crops

- Reduction of average damage (from Mean 1.9 to 1.7) by grazing of cows in home garden is not significant (MH St. = 0.870; P = 0.384): and
  - Still majority remaining at “Low” level (Median - 2)
- Damage done in neighbors’ home-gardens has reduced (from Mean 1.1 to 0.3) to the level of almost “No” (Median - 0) significantly (MH St. = 4.439; P = 0.000) after the program
Conflicts with Neighbors and Risk of Theft of Cows

- Reduced conflicts with neighbors and risk of theft of cows by increasing cut and feeding cows:
  - Without allowing long duration grazing in:
    - Private lands (from 4.3 to 2.0 hours per day)
    - Common lands (from 2.1 to 0.7 hours per day)
  - Conflicts with neighbors reduced (from Mean 0.7 to 0.1) significantly (MH St. = 4.146; P = 0.000):
    - To the level of “No”
  - Risk of theft of cows reduced from “Low” to “Very Low” (from Mean 1.9 to 0.8) significantly (MH St. = 4.503; P = 0.000) after the program
Farmers spend average 3.7 hours daily on dairy activities mainly feeding cows.

Either collecting fodder or taking cows to and from tethered grazing.

Farmers cut fodder in the morning and feed cows.

Part-time farmers (71%) cut fodder in the afternoon and request a family member to feed cows.

Average time spent on feed collecting and stall feeding has significantly reduced ($MH_{St.} = -5.127; P = 0.000$) from "High" to "Low" (from Mean 4.1 to 2.3).
Milk Consumption by Farmers’ and Neighboring Families

- Government making effort organizing awareness programs to popularize liquid milk consumption

- Average amount of domestic milk consumption of farmers has increased in 28% significantly ($Z=2.324; P=0.020$) from 0.9 to 1.1 liter/family/day

- Neighboring families have increased milk consumption in 150% significantly ($Z=4.406; P=0.000$) from average 0.7 to 1.8 liter per family per day
Number of Milk Collectors

- Average number of milk collectors increased from 2 to 5
  - 3 trustworthy informal collectors
  - Government - MILCO and private - Lucky Yogurt
- Informal market: individual consumers, and
  - Private collectors selling to collection centers, restaurants, local manufacturers of milk products and to consumers
- Farmers increased convenience of milk selling from “Low” to “High” (from Mean 2.0 to 4.0)
Community Governance to Attract Externalities

- Organizing milk farmers significantly increased (MH St. = 4.427; \( P = 0.000 \)) from Mean 0.6 to 1.5,

- Majority feel still remaining at "Low" (Median - 2) level
Further Promotion of Dairy Farming

- Farmers are “Highly” (Mean - 4.2; Median - 4) interested in further promotion of dairy farming
- Farmers have “High” and significant requirement of:
  - More funds (Mean-4.1 and Median-4; KW = 8.462; P = 0.015),
  - Shade tolerance fodder variety (Mean-3.9 and Median-4; KW = 8.337; P = 0.015) and
  - Better price for their milk (Mean-4.4 and Median-4; KW = 8.174; P = 0.017)
- Program research on shade tolerant fodder varieties to replace CO3
Conclusions and Policy Implications
Pasture program has created considerable changes in ecosystem in home-gardens, and contributed very important economic trade-offs and social breakthroughs.

The program may promote liquid milk production and consumption thus increasing fodder production in home-gardens for feeding cows.

Recommend to design sustainable silvo-pasture system with appropriate land use system based on size and composition of home-gardens.

Promotion of community governance will empower the farmers and encourage them for collective efforts to improve standards of their dairy farming.
Thank You