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R Dhivya
PG Scholar, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

M Prahadeeswaran
Associate Professor, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

R Parimalarangan
Directorate of Research, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

C Thangamani
Assistant Professor (Horticulture), Department of Vegetable Science, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

S Kavitha
Associate Professor, Department of Seed Science and Technology Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
R Dhivya
PG Scholar, Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Resource use efficiency and constraints in tomato production: A case study in Dharmapuri district, Tamil Nadu

R Dhivya, M Prahadeeswaran, R Parimalarangan, C Thangamani and S Kavitha

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Abstract
The tomato is an important vegetable crop with greater economic importance. The study was carried out to examine the resource use efficiency of tomato production in Dharmapuri district of Tamil Nadu, for which 60 farmers and 10 marketing agencies, including wholesalers, retailers, and village traders, were interviewed. It has been noted that the majority of tomato growers sold their products to wholesalers and retailers. The Cobb Douglas Production Function was used to analyze the efficiency of resource use in determining the production of tomatoes. The values of the coefficients indicate the elasticity of the various inputs to the output. The regression coefficient of plant protection chemicals, fertilizers, and human labor was found to be significant. The seasonal index was calculated and found that the price was highest in the months of July and August of the year. The Response Priority Index was constructed to identify the constraints faced by farmers and marketing agencies. It has been found that scarcity of labor and sudden price fluctuations were the major constraints.

Keywords: Tomato, resource use efficiency, marketing channel, constraints

1. Introduction
Tomato is an important vegetable crop and has great economic importance as it is considered to be one of the leading commodities in agricultural exports (Sangavi *et al*., 2020) [9]. The total global area under tomato is 46.16 lakh ha and the global production is about 1279.93 lakh tonnes. Globally the production of tomato has shown an uptrend by 33 per cent, in the last decade. In 2021, India stood as the second largest tomato-producing country with the production of twenty-one million tonnes. In 2022, the volume of fresh and chilled tomatoes exported from India accounted for approximately 89 thousand metric tons. Tamil Nadu stands twelfth place in the area and production of tomato (Horticulture Statistics at a Glance, 2018).
Though the production is higher in tomato, the productivity is considerably lower. It could be due to various reasons including the varietal unawareness, improper utilization of resources, lack of contact among farmers and extension agencies etc. (Joshi Gaurav 2011) [4] and various external factors like climate, rainfall etc (Saravanakumar *et al*., 2022) [14]. Therefore, the present study has been undertaken with the following objectives.

1.1 Objectives
1. To analyze the resource use efficiency in tomato production.
2. To identify different marketing channels to estimate their efficiencies and to estimate the various constraints encountered in production and marketing of tomato.

2. Data and Methodology
In the present study, resource use efficiency of tomato production, major marketing channels, marketing margin, price spread, marketing efficiency and the constraints encountered in production and marketing of tomato was estimated in Dharmapuri district of Tamil Nadu. Multistage sampling was employed in the study in selecting the sample respondents.

60 farmers and 10 marketing agencies (wholesalers and retailers and village traders) were randomly selected and interviewed using a pre-tested questionnaire in the study area.

2.1 Resource Use efficiency

Production function analysis was used to assess the resource use efficiency in tomato production. The association between the dependent and independent variables, Cobb- Douglas production function (Pan *et al*., 2011, Ramjilal *et al*., 2017, Tambo *et al*., 2010) [7, 8, 15] was designated for the study.
The regression is as follows,

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}\mu_t$$

Where,

Y = Tomato yield (Kg/ha)
X_1 = Quantity of seed material (g/ha)
X_2 = Quantity of manures (Kg/ha)
X_3 = Quantity of fertilizers (Kg/ha)
X_4 = Plant protection chemicals (lit/ha)
X_5 = Human labour (man days/ha)
X_6= Irrigation (Number of times/ha)
μ_t = Error term
a = intercept
b_1….b_6 are the parameters to be estimated

2.2 Price spread and Marketing efficiency

The difference between the price paid by the consumer and that received by the producer of a particular commodity refers to the price spread. (Shelke., 2009) [11].

PS = RP - PNP

Where, PS = Price Spread
RP = Retailers Selling price
PNP = Producers Net Price

The marketing efficiency is ratio of the price received by the farmer to total marketing cost and margin. (Swaminathan *et al*., 2013) [13].

a) Acharyas - Agarwal's approach

ME = FP/ (MC+MM)

Where,
ME = Marketing efficiency expressed as percentage
FP = Price received by the farmer
MC = Total marketing cost
MM = Net marketing margin

b) Shepherds Market Efficiency Method:

The ratio of price paid by the consumer's (total value of goods) to total marketing cost (Singh and Anuppam., 2010) [12] is used as a measure of marketing efficiency.

ME = (V/I – 1)

Where,

ME = Marketing efficiency
V = Price paid by consumer
I = Total Marketing Cost

2.3 Response priority Index (RPI)

To estimate the production and marketing constraints encountered by the farmers and marketing agencies, constraints were ranked based on the preferences and ranked accordingly. The Response Priority Index (RPI) was obtained by combining the proportion of responses (PR) and the priority estimate (PE), where PR for the i^{th} constraint is the ratio of the number of responses for that constraint to the overall number of responses, (Archana *et al*., 2019; Navaneetham *et al*., 2019) [3, 6] as defined by equation,

$$(RPI)_i = \frac{\sum_{j=1}^{k} f_{ij} * [(k+1)-j]}{\sum_{i=1}^{1}\sum_{j=1}^{k} f_{ij}}$$

Where,

$(RPI)i$ = Response priority index for i^{th} constraint,
f_{ij} = Number of responses for the j^{th} priority of the i^{th} constraint (i= 1, 2……, l; j= 1,2,3….k),

K = Number of the priorities (1- Very high, 2-High. 3-Moderate, 4-Less and 5-Very less),
$X_{((k+1)-j)}$= Scores for the j^{th} priority,
$\sum_{J=1}^{k} f_{ij}$= Total number of responses for the ith constraint,
$\sum_{I-1}^{K}\sum_{J=1}^{K} f_{ij}$ =Total number of responses to all the constraints.
Larger the RPI higher was the importance for that particular constraint.

3. Results and Discussion

The resource use efficiency determined by the Cobb Douglas Production Function is given below in the Table 1.

Table 1: Results of Resource use efficiency in tomato production in Dharmapuri district

S. No.	Variables	Coefficient	Std. Error	t-statistic	Prob.
1	Intercept	1.6592	1.4215	1.0467	0.3802
2	Quantity of seed material (g/ha)	-0.7324^{NS}	0.0428	-0.4324	0.6319
3	Quantity of Manures (Kg/ha)	0.0875^{NS}	0.0813	1.0761	0.2870
4	Quantity of fertilizers (Kg/ha)	0.1018**	0.0388	2.7236	0.0125
5	Plant protection chemicals (lit/ha)	0.0696**	0.0861	1.9838	0.0435
6	Human labour (man days/ha)	0.1392**	0.0653	2.3206	0.0380
7	Irrigation (Number of times/ha)	-0.0271^{NS}	0.0342	-0.6276	0.5319
	R Square	0.8137			
	Adjusted R square	0.7326			
	F Statistic	27.4713			

** Significant at 5% level and ^{NS} Not Significant.

It can be determined from Table 1 that the coefficients of multiple determination (R^2) was 0.8137 indicating that 81 per cent of the systematic variation in tomato yield could be attributed to the independent variables included in the model. In a Cobb Douglas Production Function, the coefficients denote the production elasticities of the resources used in the model. The coefficients including plant protection chemicals, human labour and fertilizers were positively influenced the yield of tomato at 5 per cent level of significance.

The results revealed that one per cent increase in quantity of plant protection chemical, human labour *Ceteris Paribus* would increase the yield of tomato by 0.069 and 0.139 per cent respectively at the existing geo-mean level. The coefficient of the variable fertilizers were found to be significant at 5 per cent level, indicating that one per cent increase in the irrigation *Ceteris Paribus* would increase the yield of tomato by 0.101 per cent at existing geo-mean level. The variables including quantity of seed material, quantity of Manures, irrigation were found to be non-significant.

3.1 Marketing channels and Margins of Tomato in Dharmapuri district of Tamil Nadu

A marketing channel is a pathway through which a produce travel from the producer to the final consumer through middlemen. Price spread of different marketing channels were calculated and analysed to determine the channel which is more efficient in marketing of Tomato in the Dharmapuri district of Tamil Nadu. (Akter *et al*., 2017) [2].

Predominant marketing channels were identified in the study district and it could be inferred that major marketing channels in marketing Tomato include,

1. Producer – Consumer (Direct marketing channel)
2. Producer – Retailer – Consumer
3. Producer – Wholesaler– Retailer – Consumer
4. Producer – Village Trader – Retailer – Consumer

Table 2: Marketing channels and Margins of Tomato (Rs. /Quintal)

S. No.	Particulars	Price			
		Channel-I	Channel-II	Channel-III	Channel-IV
A	**Producer**				
1	Producer price	1802.00	1691.00	1511.00	1505.00
2	Packaging	200.00	100.00	90.00	80.00
3	Loading/ Unloading	10.00	9.00	10.00	6.00
4	Transportation	28.00	30.00	34.00	22.00
5	Loss	160	120.00	155.00	100.00
6	Total Marketing Cost	398.00	259.00	289.00	208.00
7	Net price	1702.00	1432.00	1222.00	1297.00
B	**Wholesaler**				
1	Purchase Price	0.00	0.00	1511.00	0.00
2	Packaging	0.00	0.00	110.00	0.00
3	Loading/unloading	0.00	0.00	10.00	0.00
4	Transportation	0.00	0.00	35.00	0.00
5	Loss	0.00	0.00	90.00	0.00
6	Marketing cost	0.00	0.00	245.00	0.00
7	Sale price	0.00	0.00	1705.00	0.00
8	Marketing margin	0.00	0.00	194	0.00
C	**Village trader**				
1	Purchase Price	0.00	0.00	0.00	1505.00
2	Packaging	0.00	0.00	0.00	85.00
3	Loading/unloading	0.00	0.00	0.00	20.00
4	Transportation	0.00	0.00	0.00	40.00
5	Loss	0.00	0.00	0.00	100.00
6	Marketing cost	0.00	0.00	0.00	245.00
7	Sale price	0.00	0.00	0.00	1735.00
8	Marketing margin	0.00	0.00	0.00	230.00
D	**Retailer**				
1	Retailer Purchase Price	0	1691.00	1705.00	1735.00
2	Packaging	0	0.00	0.00	0.00
3	Loading/unloading	0	12.00	12.00	14.00
4	Transportation	0	19.00	45.00	50.00
5	Loss	0	120.00	150.00	160.00
6	Marketing cost	0	151.00	207.00	224.00
7	Sale price	0	2100.00	2107.00	2000.00
8	Marketing margin	0	309.00	402.00	265.00
E	**Consumer**				
1	Purchase price	1802.00	2100.00	2107.00	2000.00

(***Source*:** Primary survey)

From Table 2, it could be inferred that of the listed marketing channels, Channel-III had highest marketing cost of Rs. 741/ Quintal, followed by Channel-III of RS. 677/quintal and Channel-II of Rs.410/ Quintal respectively. Channel-I is the direct marketing channel. It is also revealed that channel-III had a highest marketing margin of Rs.596/quintal followed by channel-IV and channel-II of Rs.495/quintal and Rs.409/quintal respectively by the market intermediaries.

Table 3: Price spread in marketing efficiency of Tomato (Rs./qtl)

S. No	Particulars	Price			
		Channel-I	Channel-II	Channel-III	Channel-IV
1	Net price received by the producer	1802.00	1691	1511	1505
2	Total Marketing cost incurred by producer, wholesaler, retailer, village trader	398.00	410	741	677
3	Total market margin of wholesaler and retailer	0.00	309	596	495
4	Selling price of retailer/ purchase price of consumer	1802.00	2100	2107	2000
5	Price spread	0.00	409.00	596.00	495.00
6	Marketing efficiency (Acharyas and Agarwals)	4.52	2.40	0.86	1.28
7	Marketing efficiency (Shepherds)	4.52	3.37	1.84	1.95

From table 3, it could be inferred that of the listed marketing channels, Channel III had higher price spread of Rs. 596/ Quintal, followed by Channel IV and Channel II with the Price spread of Rs.495/ Quintal and Rs. 409/ Quintal respectively. Channel I is the direct marketing channel and it was observed to have no price spread. It also revealed that the marketing efficiency was higher in channel-I of 4.52 by both Acharya and shepherds marketing efficiency method followed by channel-II, channel-IV and channel-III for the Tomato crop. From the result it was concluded channel I resulted in high efficiency and channel-IV resulted in the poor efficiency of marketing of Tomato.

3.2 Varietal Preference of marketing agencies

Sago is the most preferred variety in Dharmapuri district as 60 per cent of the tomato growers cultivate this variety. It is favoured over Madhan and Kalyan due to the various reasons like spherical shape, dark red when fully ripe and exhibit consistent ripening, excellent firmness, and can be stored effectively once ripened. It is best suited for transport and storage capabilities, outperforming other round-fruited varieties by maintaining quality for 8-10 days at room temperature.

3.3 Seasonal Index

The seasonal index, which represents the relative price fluctuation compared to the average price over the entire year, indicates that the prices of tomatoes were at their lowest during March and February, and highest during May, June, July, November, and December.

The seasonal fluctuations in tomato prices can be attributed to various factors, including seasonal harvesting, Interstate arrivals, Demand – supply imbalance, Weather conditions, Transportation and storage, Market speculation etc. (Kalidas and Akila., 2014) [5].

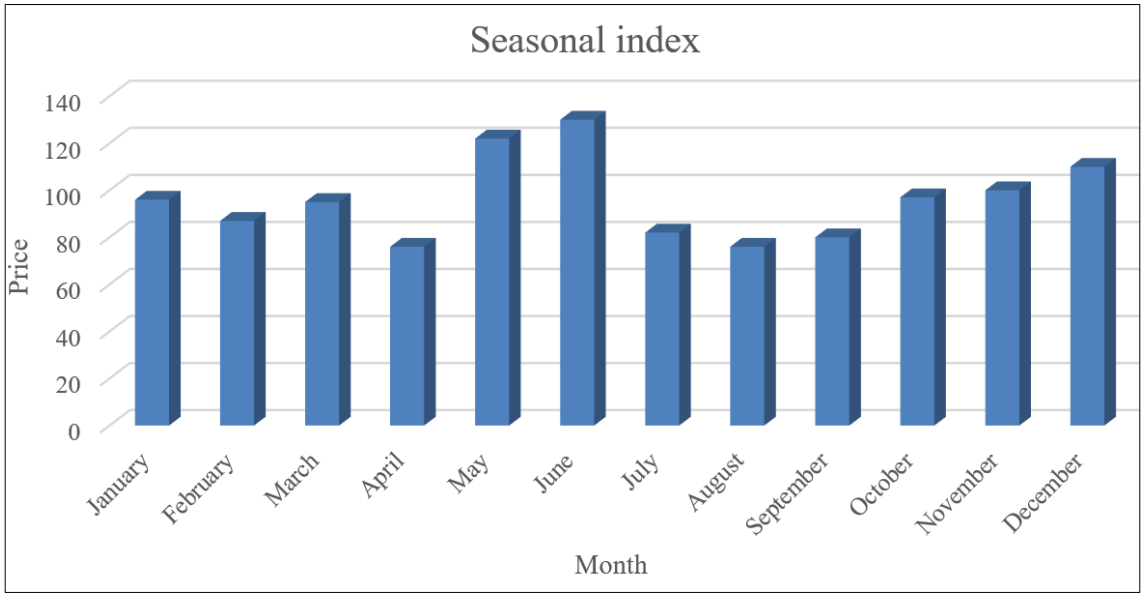
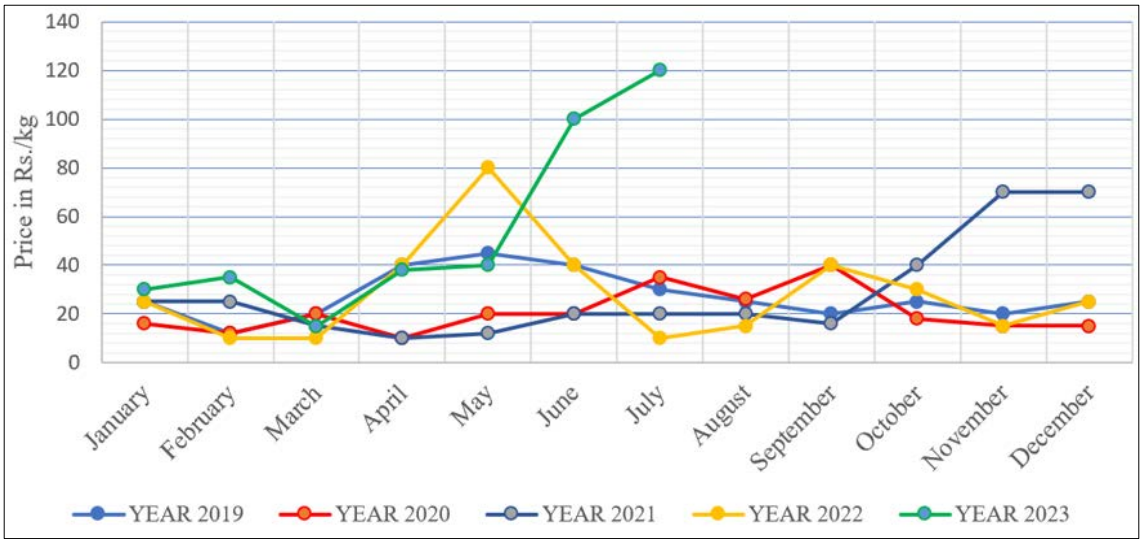


Fig 1: Seasonal index of Tomato

If the value is greater than 100, then the price was greater than the average. This would usually happen in the month of July, November, December because of less arrivals of tomato from Andhra Pradesh and Karnataka market to Tamil Nadu market. In June 2023 the price has gone up to Rs. 12000/ quintal.



Source: (http://www.indiastat.com 2023)

Fig 2: Monthly variations in the prices of tomato from January 2019 to May 2023

3.4 Constraints encountered by farmers and Marketing agencies

All the farmers were interviewed for the problems they are facing while producing and marketing of vegetables. The information regarding the important problems faced by the growers is presented in Table 4.

Table 4: Production Constraints

S. No.	Constraints	Index value	Rank
1	Scarcity and high cost of labor	0.75	1
2	Lack of access to institutional credit by farmers	0.68	4
3	Small size of Landholdings by farmers	0.51	6
4	Poor availability of inputs	0.45	7
5	High incidence of pest and diseases	0.72	2
6	Higher Cost of inputs and fewer subsidy	0.70	3
7	Technological Illiteracy	0.54	5

From Table 4, it could be inferred that the major production constraint countered was high cost of labor with RPI score of 0.75. The second and third major constraint was high incidence of pest and diseases and higher cost of inputs and fewer subsidies with RPI Score of 0.72 and 0.70 respectively.

3.5 Marketing Constraints

The marketing constraints encountered by the marketing agencies were given in the Table 5.

Table 5: Marketing Constraints

S. No.	Constraints	Index value	Rank
1	Lack of cold storage facilities for vegetables	0.69	3
2	Improper dissemination of market information	0.65	4
3	Unorganized marketing system	0.52	7
4	Higher storage cost	0.48	8
5	Frequent price fluctuation of vegetables	0.73	1
6	Lack of transportation facility	0.70	2
7	Low Profit from sale of vegetables	0.60	5
8	Heavy losses in market	0.55	6

From Table 5, it could be inferred that the major marketing constraints encountered include frequent price fluctuation of vegetables with RPI score of 0.73. The second and third major constraints include lack of transportation facility and lack of cold storage facilities for vegetables with RPI Score of 0.70 and 0.69 respectively.

4. Summary and Conclusions

The study made an attempt to estimate the efficiency of resource use in tomato crop and to estimate the major marketing channels and the production and marketing constraints of Tomato in Dharmapuri district of Tamil Nadu. The results of the Cobb Douglas production function in estimating the resource use efficiency, revealed a positive significant relationship of the variables including quantity of fertilizer (Kg. /ha), plant protection chemicals (lit/ha) and human labour (man days/ha) applied to the Yield of Tomato (Kg/ha). Direct marketing channel was observed to be the efficient marketing channel and had highest marketing efficiency because of its significant lower price spread, whereas the Channel III (Producer – Wholesaler– Retailer – Consumer) was observed to be the inefficient marketing channel and had poor marketing efficiency of tomato because of the highest price spread of the channel with Rs. 596/Quintal and the involvement of large number of intermediaries. The major production constraints encountered farmers and marketing agencies include high cost of labor, high incidence of pest and diseases, and higher cost of inputs and fewer subsidies. The major marketing constraints encountered by farmers and marketing agencies include frequent price fluctuation of vegetables, lack of transportation facility and lack of cold storage facilities for vegetables.

5. References

1. Horticulture Statistics at a Glance, Government of India, Ministry of agriculture and farmers welfare, Department of Agriculture, Cooperation and farmers Welfare. Horticulture statistics division; c2017. p. 514.
2. Akter S, Islan MS, Rahman MS. An economic analysis of Winter-Vegetables production in some selected areas of Narsingadi district. Journal of Bangladesh Agrilculture University. 2011;9(2):241-246.
3. Archana K, Srinivasa Rao H, Rambala P. Constraints and Suggestions Perceived by MGNREGA Beneficiaries and Stakeholders in Srikakulam district of Andhra Pradesh. International Journal of Agriculture Sciences. 2019;11(6):8030-8033.

4. Joshi Gaurav. Ananalys is of marketed surplus of Brinjal in Western Uttar Pradesh. Asian Journal of Management Research. 2011;2(1):484-490.
5. Kalidas K, Akila K. Micro level investigation of marketing and post-harvest losses of tomato in Coimbatore district of Tamil Nadu. Journal of Stored Products and Postharvest Research. 2014;5(1):1-7.
6. Navaneetham B, Mahendran K, Sivakumar SD. Analysis of constraints for performance improvement of FPCs in Tamil Nadu. International Journal of Farm Sciences. 2019;9(2):12-18.
7. Pan RS, Suresh Kumar, Govind Pal, Singhand AK, Tirkey I. Economics and resource use efficiency of Tomato (*Solanum lycopersicum*) cultivation in Jharkhand. New Agriculturist. 2011;22(2):185-192.
8. Ramjilal Choudhary, Rathore DS, Amod Sharma. Economic Affairs. 2017 Sept;62(3):547-553.
9. Sangavi M, Janaki Rani A, Pushpa J, Prabakaran K. Socio-Economic Status of Tomato Growers in Madurai District of Tamil Nadu, Ind. J Pure App. Biosci. 2020;8(6):511-514.
DOI: http://dx.doi.org/10.18782/2582-2845.8483
10. Sangeeta R, Banemathy V. An economic analysis of marketing of major Vegetables in Cuddalore district. International Journal of Current Research. 2011;3(4):309-312.
11. Shelke R. Economics of Price Spread in marketing of major Vegetables in Parbhani Market. Economic Affairs. 2009;54(3)&(4):118-123.
12. Singh RP, Anupam Toppo. Economics of production and marketing of tomato in Kanke block of Ranchi district. Indian Journal of Agricultural Marketing. 2010;24(2):1-16.
13. Swaminathan A, Anbarassan KC, Siva Balan, Murali S, Gopal M, Chinnadurai. Market and Marketing Efficiencies of vegetable trading in the Coimbatore District of Tamil Nadu: An Economic Analysis. Golden Research Thought. 2013;2(10):1-8.
14. Saravanakumar V, Heman DL, Balasubramanian R. A district-level analysis for measuring the effects of climate change on production of rice: Evidence from Southern India. Theoretical and Applied Climatology. 2022;150:941:953. https://doi.org/10.1007/s00704-022-04198-y
15. Tambo, Justice Akpene, Theresa Gbemu. Resource-use efficiency in tomato production in the Dangme West District, Ghana." In Conference on International Research on Food Security, Natural Resource Management and Rural Development. Tropentag, ETH Zurich, Swzld; c2010.