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Phosphorus Response and Amino Acid Composition of Different Green Gram (*Vigna radiata* L.) Genotypes from Myanmar

M. Kywe [1], **M.R. Finckh** [2] and **A. Buerkert** [3*]

Abstract
Mungbean or green gram (*Vigna radiata* L.) is an important component of rice-based cropping systems in Myanmar, where grain yields of around 800 kg ha^{-1} are much below its yield potential of 3000 kg ha^{-1}. The reasons for this shortfall are as under-investigated as is the genotype-specific response of this crop to phosphorus (P) application, which is critically low in many Myanmar soils, and the genetic variation in grain quality. For green gram quality, the concentration of lysine, an essential amino acid is particularly important given its scarcity in many cereal-based diets of Southeast Asia. The purpose of this study therefore was to investigate the effects of P application on the root and shoot growth, yield and its components for a range of green gram varieties, and to analyse the protein concentration and amino acid composition in green gram seed of different origins. To this end from 2001 to 2003, field experiments were conducted under rain-fed conditions in Yezin and Nyaung Oo. Fifteen landraces and five introduced green gram cultivars were grown at two levels of P (0 and 15 kg ha^{-1}). There were large genotypic differences in P effects and a significant interaction between green gram genotypes and P for shoot and root growth. An unexpected benefit of P application was a reduction of pest and plant virus infestation in the field. Significant genotypic differences in the amino acid profile of seeds were also observed. The results indicate the potential for breeding efforts to increase seed yield and protein quality in green gram.

Keywords: Landraces, lysine, mungbean, protein quality

1 Introduction

Since prehistoric times, green gram (*Vigna radiata* L.) has been an important short-season grain legume and staple diet of humans and livestock throughout S.E. Asia (Thomas *et al.*, 2004). Grown widely in this region, green gram is one of the least researched and under-exploited major grain legumes (Lawn and Ahn, 1985). In Myanmar, throughout the year, this crop is an important component of the country's rice-based

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cropping systems, where legumes cover about 8.5% of the total cultivated area and in combination with chickpea (*Cicer arietinum* L.), lima bean (*Phaseolus lunatus* L.), black gram (*Vigna mungo* L.), pigeonpea (*Cajanus cajan* L.) and lablab bean (*Lablab purpureus* L.) it accounts for 80% of all harvested grain legumes (THAUNG, 1989). In recent years Myanmar has replaced Australia as the world's second largest exporter of grain legumes after Canada (MYANMAR TIMES, 2002). The main buyers of Myanmar's grain legumes are India and Japan, with new markets emerging in Jordan and Pakistan. Among the best selling Myanmar grain legumes on export markets are black gram, green gram and pigeonpea. For green gram, this demand is partly rooted in its seed protein ranging between 19 and 29% and in its high lysine concentration which is the major limiting amino acid in cereal proteins for humans and monogastric animals (JOOD and SINGH, 2001). This is particularly true for populations in SE Asia with their reliance on rice-based diets. In the future, local demand and export opportunities for green gram may thus partly depend on its lysine concentrations. With current grain yields of around 800 kg ha^{-1} green gram in Myanmar is significantly below the reported yield potential (around 3000 kg ha^{-1}) and little is known about the reasons for this shortfall.

Since 1991 the Japan-Myanmar Seed Bank Project has collected traditional land races of green gram. However, so far this germplasm has not been evaluated for agronomic traits such as growth, yield, nutrient uptake and quality for human nutrition. Given the low on-farm yields of green gram in Myanmar and its importance in local diets, there may be considerable potential for an even increased use of this crop after proper breeding for heritable traits (ANISHETTY and MOSS, 1988). Exploiting the genetic diversity of plants for enhanced productivity in low fertility soils is an important goal of modern plant breeding (GOURLEY *et al.*, 1994) and genotypes with high phosphorus (P) use efficiency (with respect to both uptake and translocation) would be particularly valuable in Myanmar where mineral P fertilizers are hardly available and many soils are low in P (GUNAWARDENA *et al.*, 1992). The aims of this paper therefore were (i) to examine differences in growth response to P application among green gram varieties and (ii) to compare the amino acid composition in green gram seed of different origins.

2 Methodology

2.1 Site conditions and experimental setup

From 2001 to 2003 three field experiments were conducted under rainfed conditions at Yezin Agricultural University Farm (YAU, 19° 38'N latitude, 96° 50'E longitude, 102 m altitude, average total precipitation 1000 mm from May to October) and Nyaung Oo (21° 10'N latitude, 94° 54'E longitude, 70 m altitude, average total precipitation 450 mm from May to October) in Myanmar. The first experiment at YAU comprised 15 landraces and five introduced green gram cultivars grown with 0 and 15 kg P ha^{-1} applied as basal triple-super phosphate (TSP with 21% P) from 15th June to 30th September 2001 with 1169 mm rainfall (Table 1).

The soil properties (0-0.2 m depth) of the site were pH-water 5.6, 0.05 g total nitrogen (N) kg^{-1} soil and 6.8 mg Bray-1 P kg^{-1}. A split-plot design with three replications was used with P application as the mainplot factor and genotypes randomly attributed

Table 1: List of improved cultivars and landraces of green gram (*Vigna radiata* L.) tested for their growth response to phosphorus and for their amino acid composition in a field experiment in Myanmar, 2001.

Experiment/ Identifier		*Genotype*	*Accession number*	*Classification*	*Provenance*
1,2,3	(A)	V-3726	-	Improved	AVRDC*
1	(B)	Yezin-4	-	Improved	AVRDC
1,2,3	(C)	VC-5205A	-	Improved	AVRDC
1,2,3	(D)	Kanti	-	Improved	Bangladesh
1,2,3	(E)	Myakyemon	-	Improved	Kyemon Station
1,2	(F)	Yegyi-kangoo	004200	Landrace	Yegyi township
1	(G)	Myaung	004199	Landrace	Myanung township
1,2	(H)	Gangaw-7375	007375	Landrace	Gangaw township
1,2	(I)	Yinmarbin	004184	Landrace	Yinmarbin township
1,2	(J)	Gangaw-4187	004187	Landrace	Gangaw township
1,2,3	(K)	Pakhoku	007379	Landrace	Pakhoku township
1	(L)	Gangaw-7380	007380	Landrace	Gangaw township
1	(M)	Magwe	004198	Landrace	Magwe township
1	(N)	KhinOo	004201	Landrace	KhinOo township
1,2,3	(O)	Ayadaw	007354	Landrace	Ayadaw township
1,2	(P)	Kyemon	004192	Landrace	Kyemon township
1,2	(Q)	Thawatti	004185	Landrace	Thawatti township
1,2	(R)	Nyaunglaybin	004186	Landrace	Nyaunglaybin township
1,2	(S)	Mahling	004197	Landrace	Mahling township
1,2	(T)	Pauk	007377	Landrace	Pauk township

* Asian Vegetable Research and Development Centre

to subplots. Land preparation was done by tractor with one ploughing followed by two harrowings. Plant spacing was 0.45 m between and 0.10 m within rows with 10 plants per row. Fertilizers were band-placed at 2 cm soil depth and incorporated into the soil before sowing. Weeding was done by hand and pest control during the vegetative stage of the crop by two applications of the synthetic pyrethroide cypermethrin (26% active ingredient) at a rate of 7.5 l ha^{-1}. Total dry matter (TDM) as well as shoot and grain yield obtained from the experiment were subjected to analysis of variance. Amino acids in the seed were analysed using an amino acid analyser following the procedure of VDLUFA (1988).

In a second experiment conducted from end of June to early October 2002 at Nyaung Oo Research Farm eleven landraces (named Yegyi-kangoo, Gangaw-4187, Yinmarbin, Pakhoku, Ayadaw, Kyemon, Thawatti, Nyaunlaybin, Mahling, Pauk and Gangaw-7375) and four introduced green gram cultivars (V-3726, VC-5205A, Kanti and Myakyemon) were grown with 0 and 15 kg P ha^{-1} (applied as basal TSP) at 413 mm rainfall. Fertilizers were band-placed at 2 cm soil depth and incorporated into the soil before sowing. The 11×2 factorial experiment was arranged in a randomized complete block design (RCBD) with four replications. The site had a pH-water of 7.2, 0.02 g total N

kg^{-1} and 5.7 mg Bray-1 P kg^{-1}. Land preparation was done by tractor. Plant spacing was 0.45 m between and 0.10 m within rows with 5 m length. For the estimation of insect damage, representative leaves were selected and the 'technique of the four quarters' was used to estimate the relative area of holes in the leaves at flowering. Heavy pest infestation was found at harvesting. For the estimation of mungbean mosaic virus damage, the number of virus-diseased plants was recorded following a scoring key of 0 to 2 (0 = no symptoms, 1 = some mosaic, 2 = heavy mosaic symptoms with stunting and/or leaf rolling and/or mosaic) (JAMES, 1971). No other diseases were detected. For measurements of root length density following the line intersection method of TENNANT (1975) a total of ten samples at 0 to 0.2 m depth were taken in each plot of three of the four blocks. Samples were pooled at the plot level, transported to Yezin, washed and analysed.

In the third experiment from end of May to early October 2003 a subset of four introduced cultivars (V-3726, VC-5205A, Kanti and Myakyemon) and the two green gram landraces Pakhoku and Ayadaw were grown again with 0 and 15 kg P ha^{-1} as TSP at YAU with 727 mm rainfall. A factorial design with four complete blocks (replications) comprising twelve treatment combinations (plots) each was used. Root growth at flowering was measured by inserting an aluminium tube of 25 mm diameter five times per plot to 0-10 cm and 10-20 cm depth. Ink-stained roots (to ease counting) from the samples, pooled for each depth interval and plot, were used to determine root length density. Shoot growth of green gram was determined at each root sampling and analysed for N and P.

2.2 Pot experiment

Two of the improved cultivars, V-3726 and Yezin-4 tested in both field experiments at YAU and the most P responsive landraces, Ayadaw and Mahling were chosen for a pot experiment under controlled (greenhouse) conditions in Germany to examine possible varietal differences in N and P uptake. To this end TSP equivalent to 0 and 15 kg P ha^{-1} was mixed with 4 kg of the C-horizon of a P poor sandy soil from Bischhausen, Germany in 32 pots (4×2 factorial in a completely randomized design with 4 replicates) of 5 l volume. The soil's properties were pH-water of 7.8, 0.0015 g total N and 1.7 mg Olson-P kg^{-1} soil. For each green gram genotype four seeds of similar size were planted at a depth of 2 cm. Deionized water was applied daily to 10% w/w to account for evapotranspiration losses. No rhizobium inoculation was made. To avoid the effects of climate gradients on plant development, the pots were re-randomised every two days. Ten days after sowing (DAS) seedling were thinned to 1 plant per pot. All plants were harvested by 30th December 2001 when dry matter of roots and shoots (stems, pods and seeds) and the number of nodules per plant was determined. Total N was measured with a Macro-N-Analyser (Heraeus, Bremen, Germany). For P analysis shoot and seed samples were ashed for 4 hrs in a muffle furnace at 500 °C and the ash was dissolved in 1:30 (v/v) HCl. Phosphorus was determined colourimetrically (Hitachi U-2000 spectrophotometer). Stained roots from the samples were used for root length determination.

2.3 2.3 Data analysis

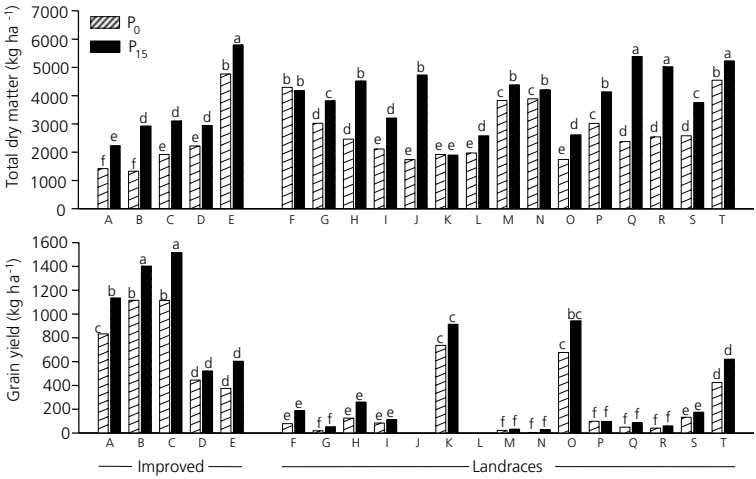
All data on yields and nutrient concentrations were subjected for each season separately to analysis of variance (ANOVA) using GENSTAT 5 (Lawes Agricultural Trust, 2000). Treatment means were separated using Fisher's protected $LSD_{0.05}$. Disease score data were also analyzed by F-tests, whereby given the typically lacking normal distribution of such data, F-values are only approximative.

3 Results

3.1 Field experiments at Yezin and Nyaung Oo

In 2001 and 2002, highly significant TDM and grain yield differences between green gram genotypes and significant, site-specific $\mathrm{P} \times$ genotype interactions were found for both parameters (Fig. 1 and 2). At Yezin across P levels the grain yield of the improved cultivar VC-5205A was highest but not significantly higher than the yield of Yezin-4. The yield of V-3726 was also high, but was significantly lower than that of the other two cultivars (Fig. 1).

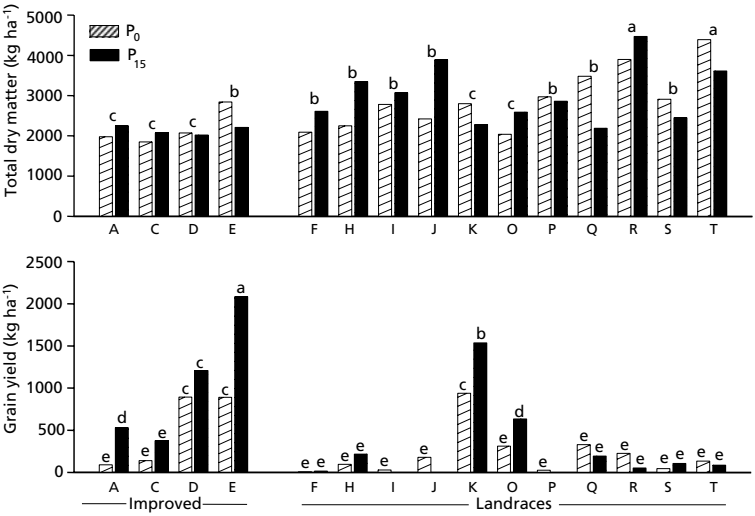
Figure 1: Effects of phosphorus (P) application at 0 and 15 kg P kg^{-1} as triple superphosphate on total dry matter and grain yield of 20 green gram genotypes grown in a field experiment at Yezin, Myanmar, 2001. *



* Cultivar identifiers are given in Table 1. Columns marked with different letters are significantly different at $P<0.05$.

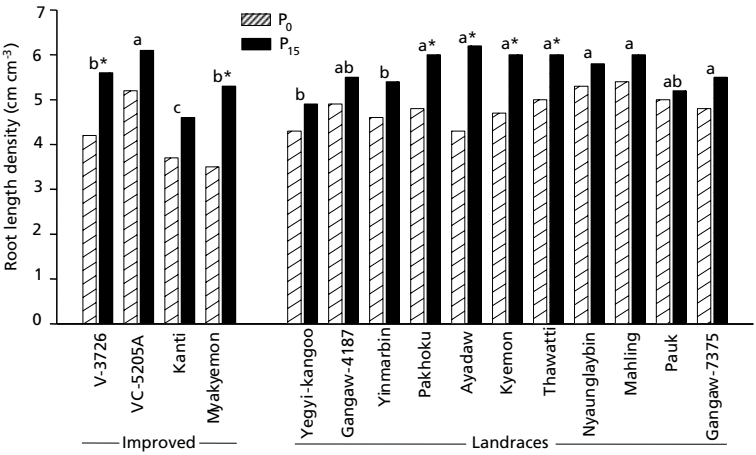
Among the landraces, Pakhoku and Ayadaw had the highest grain yields. No grain yields were harvested for Gangaw-4187 and Gangaw-7380 because of poor pod setting. In 2002 at Nyaung Oo, no grain yields were recorded for Gangaw-4187, Yinmarbin and Kyemon when P-fertilizer was applied, although they flowered (Fig. 2). Grain yields of the Myakyemon cultivar, in contrast, were twice as large with P than in the control treatment without P.

Figure 2: Effects of phosphorus (P) application at 0 and 15 kg P kg^{-1} as triple superphosphate on total dry matter and grain yield of 15 green gram genotypes grown in a field experiment at Nyaung Oo, Myanmar, 2002. *



* Cultivar identifiers are given in Table 1. Columns marked with different letters are significantly different at $P<0.05$.

Figure 3: Root length density of 15 green gram cultivars grown in a field experiment at Nyaung Oo, Myanmar, 2002 (0 and 15 kg P kg^{-1} as TSP). *



* Columns marked with different letters are significantly different at $P<0.05$

Figure 4: Effect of phosphorus (P) application at 0 and 15 kg P kg^{-1} as triple superphosphate on total dry matter and grain yield of six green gram genotypes grown at Yezin, Myanmar, 2003.

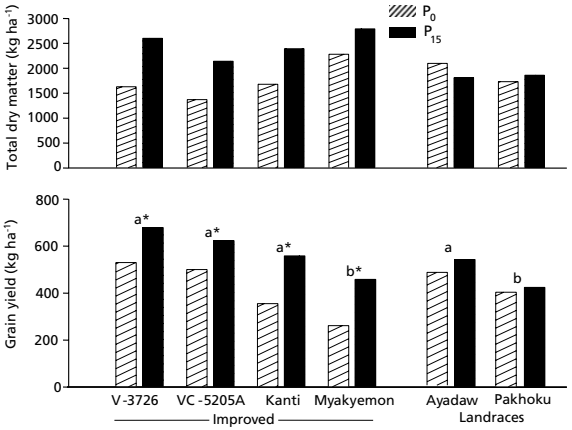
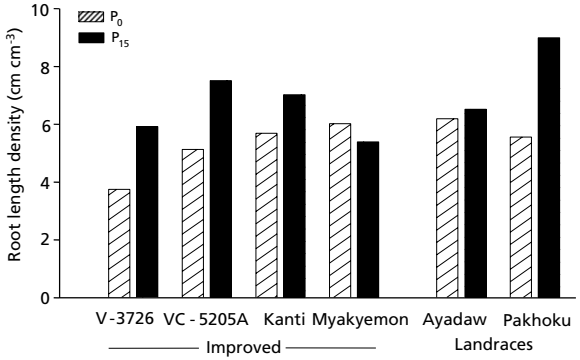


Figure 5: Effect of phosphorus (P) application at 0 and 15 kg P kg^{-1} as triple superphosphate (TSP) on root length density of six green gram genotypes grown at Yezin, Myanmar, 2003.



Root length density of all genotypes was significantly higher with P than in the unfertilised controls (Fig. 3). Significant differences in TDM and grain yield of green gram genotypes were noted again at Yezin in 2003 whereby TDM yields of the landraces Pakhoku and Ayadaw did not respond to P application even if RLD was significantly increased in both (Fig. 4 and 5).

At both sites P application reduced virus damage (Table 2 and 3). Compared to the unfertilised controls at Yezin, P application lead to an increased pest damage in improved cultivars and to its decrease in landraces. Although not significant, P application increased tissue N and P concentrations in all genotypes except for Kanti and Pakhoku, respectively (Table 4).

The analyses also showed large genotypic variation in the amino acid composition of the seeds in the ten green gram genotypes whereby Gangaw-4187, Magwe and Mahling had the highest lysine concentrations (Table 5).

Table 2: Effects of phosphorus (P) application at 0 and 15 kg P ha^{-1} on pest damage (%) and virus incidence (scored from 0 to 2) in different green gram cultivars at Nyaung Oo, Myanmar, 2002.

Cultivar †	*Pest damage (%)*		*Virus score* *	
	P_0	P_{15}	P_0	P_{15}
V-3726	12.1	11.5	1.5	1.3
VC-5205A	10.3	8.2	1.3	1.3
Kanti	7.4	10.9	1.5	1.0
Myakyemon	8.2	7.1	0.8	0.8
Yegyi-Kangoo	10.3	8.2	1.3	1.5
Gangaw4187	6.9	8.4	1.3	1.0
Yinmarbin	6.3	4.1	1.0	0.5
Pakhoku	10.2	9.3	1.3	1.3
Ayadaw	12.3	8.1	1.5	1.0
Kyemon	8.1	7.9	1.3	1.0
Thawatti	7.2	10.3	1.0	0.3
Nyaunglaybin	6.2	10.1	0.5	0.5
Mahling	7.3	9.9	1.8	1.8
Pauk	8.9	9.1	1.5	0.5
Ganggaw7375	8.2	7.1	1.3	1.5
Means	8.66	8.68	1.3	1.0
$LSD_{0.05}$ for P ‡	-		0.22	
$LSD_{0.05}$ for C ‡	-		0.54	
	Pr > F §			
P	0.520		0.031	
Genotype	0.228		0.003	
Genotype × P	0.741		0.707	

* Scores were: 0 = no symptom, 1 = some mosaic, 2 = heavy mosaic virus

† Improved (V-3726, VC-5205A, Kanti, Myakyemon); Landraces (Yegyi-Kangoo, Gangaw4187, Yinmarbin, Pakhoku, Ayadaw, Kyemon, Thawatti, Nyaunglaybin, Mahling, Pauk, Ganggaw7375)

‡ Least significant difference at $P<0.05$

§ Probability of a treatment effect (significance level)

Table 3: Effects of phosphorus (P) application at 0 and 15 kg P ha^{-1} on pest damage (%) and virus incidence (scored from 0 to 2) in different green gram genotypes at Yezin, Myanmar, 2003.

Cultivar *	*Pest damage (%)*		*Virus score*	
	P_0	P_{15}	P_0	P_{15}
V-3726	6.5	6.7	1.5	0.8
VC-5205A	9.8	13.4	1.0	0.8
Kanti	6.9	10.3	1.5	0.5
Myakyemon	9.6	5.3	0.3	0.5
Pakhoku	11.5	8.8	0.5	0.5
Ayadaw	10.9	6.3	1.3	1.0
$LSD_{0.05}$ for P †	-		0.31	
$LSD_{0.05}$ for C †	-		0.54	
	$Pr > F$ ‡			
P	0.635		0.037	
Genotype	0.520		0.026	
Genotype × P	0.485		0.207	

* Improved: V-3726, VC-5205A, Kanti and Myakyemon; Landraces: Pakhoku and Ayadaw
† Least significant difference
‡ Probability of a treatment effect (significance level)

Table 4: Effects of phosphorus (P) application at 0 and 15 kg P ha^{-1} on nitrogen and phosphorus concentration (mg kg^{-1}) in different green gram genotypes at Yezin, Myanmar, 2003.

Cultivar *	*Nitrogen*		*Phosphorus*	
	P_0	P_{15}	P_0	P_{15}
V-3726	30.3	31.6	3.14	3.18
VC-5205A	31.6	33.9	3.18	3.65
Kanti	33.8	31.8	3.35	3.38
Myakyemon	34.1	35.1	3.26	3.58
Pakhoku	32.4	32.3	3.09	3.02
Ayadaw	31.5	34.7	3.22	3.29
	$Pr > F$ †			
P	0.352		0.093	
Genotype	0.492		0.092	
Genotype × P	0.739		0.421	

* Improved: V-3726, VC-5205A, Kanti and Myakyemon; Landraces: Pakhoku and Ayadaw
† Probability of a treatment effect (significance level)

Table 5: Amino acid concentrations (mmol mmol^{-1} protein) in seeds of three improved cultivars and seven landraces of green gram from Myanmar, 2001.

Amino acid	*V-3726*	*VC-5205*	*Yezin-4*	*Ayadaw*	*Mahling*	*Gangaw-4187*	*Yegyi-Kangoo*	*Thawatti*	*Nyaung*	*Magwe*
Aspartate	204	185	202	242	253	259	236	245	193	256
Threonine	72	71	71	80	85	85	81	81	63	87
Serine	116	116	114	135	142	145	136	134	110	142
Glutamate	281	280	278	332	357	357	331	334	255	350
Glycine	123	124	131	144	165	162	148	152	122	164
Alanine	118	117	117	136	144	146	138	136	110	144
Cystine	5	5	5	5	6	6	4	5	4	6
Valine	112	109	115	131	135	138	131	132	104	137
Methionine	6	9	10	9	15	11	9	12	13	13
Isoleucine	79	77	78	93	93	96	92	93	73	96
Leucine	148	144	143	174	180	185	172	174	137	179
Tyrosine	34	33	34	40	44	42	40	42	32	45
Phenyalanine	84	83	81	100	103	106	98	102	79	104
Histidine	44	43	43	51	52	54	52	51	40	53
Lysine	117	115	118	134	144	146	137	139	110	146
Arginine	87	85	84	105	108	111	105	105	80	109
Proline	90	91	91	107	108	110	105	105	84	113
Protein (%)	36.0	36.1	35.9	35.7	35.4	35.5	35.7	35.9	36.0	35.6
Total (mmol)	1720	1687	1714	2018	2134	2158	2017	2042	1609	2144

3.2 Pot experiment

Across genotypes P application led to large increases in TDM and pod dry matter whereby TDM was highest for V-3726, although this difference was not significant. In contrast there were no genotypic differences for both parameters (Table 6). Similarly to shoot dry matter, there were no genotypic differences on RLD but compared to the unfertilised controls P application led to respective increases in RLD by 70%, 59%, 45% and 71% for cultivars V-3726, Yezin-4, Ayadaw and Mahling. Irrespective of P application and across genotypes grain N concentration was higher than shoot N whereby without P landraces tended to have lower shoot N than the improved genotypes V-3726 and Yezin-4 (Table 7). While P application led in all genotypes to significant increases in TDM and grain yield, genotype differences were only significant for grain yield.

Table 6: Effects of phosphorus (P) application at 0 and 15 kg P ha^{-1} on total dry matter (TDM), grain yield and root length density (RLD) of four green gram (*Vigna radiata* L.) cultivars grown in a pot experiment.

Cultivar *	*TDM* (*g plant*$^{-1}$)		*Grain yield* (*g plant*$^{-1}$)		*RLD* (*cm cm*$^{-3}$)	
	P_0	P_{15}	P_0	P_{15}	P_0	P_{15}
V-3726	3.7	6.2	1.2	1.5	5.7	7.0
Yezin-4	3.7	5.9	1.0	1.7	2.4	6.3
Ayadaw	3.8	5.5	0.9	1.1	3.9	4.8
Mahling	3.3	5.6	1.4	2.1	3.0	5.3
$LSD_{0.05}$ for P†	0.61		0.40		0.16	
			$Pr > F$ ‡			
P	0.001		0.026		0.001	
Cultivar	0.715		0.106		0.332	
Cultivar × P	0.774		0.788		0.587	

* Improved: V-3726, Yezin-4; Landraces: Ayadaw and Mahling
† Least significant difference
‡ Probability of a treatment effect (significance level)

4 Discussion

The field experiments indicated a large genotypic variation in the TDM and grain yield increase following P application that was, however, not reproducible in the pot experiment. This could be due to the differences in the soils' chemical properties, but also to the lower light intensity and temperature in the German greenhouse conditions compared to the field conditions in Myanmar. Another reason may be genotypic differences in root growth that did not become apparent in the pot experiment with its restricted soil volume.

Table 7: Effects of phosphorus (P) application at an equivalent rate of 0 and 15 kg P ha^{-1} on shoot and seed nitrogen (N) concentration (mg g^{-1}) of four green gram genotypes grown in a pot experiment.

Cultivar *	*Shoot*		*Seed*	
	P_0	P_{15}	P_0	P_{15}
V-3726	1.59	1.38	3.03	3.38
Yezin-4	1.46	1.15	3.04	3.37
Ayadaw	1.27	1.38	3.04	2.98
Mahling	1.01	0.91	3.55	3.61
$LSD_{0.05}$ for C †	0.27		0.19	
	$Pr > F$ ‡			
P	0.147		0.084	
Genotype	0.002		0.003	
Genotype × P	0.424		0.350	

* Improved: V-3726, Yezin-4; Landraces: Ayadaw and Mahling
† Least significant difference
‡ Probability of a treatment effect (significance level)

For groundnut in India (*Arachis hypogaea* L.) Chahal and Virmani (1973) reported significant genotypic differences in shoot growth after super phosphate application on a P poor soil. From an experiment in Sri Lanka Gunawardena *et al.* (1992) reported that green gram genotypes differed in growth response to P application leading to the conclusion that there may be scope for breeding efforts to enhance the growth response to P and thus the P use efficiency in this crop which suffers from P deficiency on many Asian soils with high P fixation and soil acidity. Another important reason for such future breeding efforts may be lacking availability of P fertilizers on national markets such as in Myanmar where annual NPK fertilizer consumption rate from 1983-85 to 1993-95 decreased by 4.7 % (FAO, 1996). For common bean (*Phaseolus vulgaris* L.) Araujo and Teixeira (2003) reported a high correlation between grain N and P concentrations and grain yield whereas the results of this study did not show any such correlation ($r = 0.30$ for N and $r = 0.21$ for P).

An effect which merits further study is the observed cultivar-specific reduction of virus infection with P application. Similar results were found earlier for *Phaseolus* beans by Costa (1976). In papaya (*Carica papaya* L.) the role of adequate plant nutrition for reduced infection and incidence of ring spot virus was demonstrated by Ray *et al.* (1999). Phosphorus application was also found to control crop diseases by enhancing mycorrhizal activities (Whipps, 2004). Differences in seed N due to P application were small in the experiments of our study. This is in contrast to findings of Shahi *et al.* (2002) in India who reported protein increases in green gram by 21% with the application of 26 kg P and 20 kg S ha^{-1}.

Although the overal protein quality was similar, the higher lysine and methionine concentrations (amount) in the Gangaw-4187, Magwe and Mahling, landraces was likely related to their lower seed yield. Genetic variation in lysine concentration is certainly important for future breeding programmes. However, it remains open to further investigation, how large genotype $\times$ environment interactions are for this trait.

5 Conclusions

This study indicated large genotypic differences for the effects of P application on shoot and root growth of green gram. In general grain yields were higher for improved cultivars than for landraces. The Myakyemon, Kanti and Pakhoku cultivars should be grown in the Nyaung Oo area while V-3726, VC-5205A and Ayadaw yielded better in the Yezin area. The particularly high lysine and methionine concentrations (amount) in the Myanmar landraces Gangaw-4187, Magwe and Mahling makes this germplasm interesting for regional quality breeding programs of green gram.

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Properties of New Reclaimed Soils in the Merowi Irrigation Project of North Sudan

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Abstract
This study is a correlation analysis between main productivity limiting soil parameters of desert soils of North Sudan. The indications are based on data of 52 soil profiles representing the desert plain as the main land form of the region. The results show a high significant correlation of cation exchange capacity with both clay and silt in two soil depths. This positive correlation is a new guide for better understanding of the colloidal behaviour of desert soils. The salinity and sodicity interactions of the studied soils were tested via correlation analyses of EC_e, ESP and SAR for salinity and sodicity, respectively. The high positive correlation between EC_e and ESP indicates a strong association of saline and sodic soils in the desert plain of Northern Sudan. The high positive correlation of ESP and SAR enables a formula to estimate ESP by using the SAR data.

Keywords: Colloidal activity, desert soils, salinity, sodicity, Sudanese soils

1 Introduction

In recent soil survey studies that cover about 390,857 ha in North Sudan, located between longitudes 30° 20' and 31° 50' and latitudes 17° 45' and 19° 45', about 30% of the total area were identified as Desert Plain Soils (Lahmeyer International, 2005). The same soil survey findings revealed high soil variability within the plain, mainly in $CaCO_3$ content, soil depth, dominant textural class and salt accumulation. The high variability of soils of the desert plain in North Sudan is a consequence of variability in intensity and prevalence of effects of different soil factors on soil processes and formations.

The soils that were selected for this study originate from alluvial and colluvial deposits of undifferentiated fine to coarse textured superficial deposits (Lahmeyer International, 2004). This may contribute to another source of high variability within these

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soils. The hyper aridity of the plain associated with the presence of geomorphologic inclusions is resulting in localized salty depressions (BONIFICA-GEOEXPERTS, 1986).

The variation in soil textural classes, ranging from gravelly to clay loam, formed on lithic contact of Nubian Sandstone Formation, may explain why these soils are mostly of shallow depths. Likewise, the soils of the desert plain are affected with adjacent sand plains that appear in many places as infillings of old wadies interrupted in the area.

With consideration of the above mentioned variability of soils of the plain and revised sources of variability, this study is objected towards deeper understanding of main properties of the plain soils through studying the multiple and pairwise correlations between different properties of the desert soils and how their characteristics are related to each other.

2 Materials and Methods

The soil data that have been analysed in this study were collected from recent soil survey documents of the Merowi Irrigation Project, which is a newly proposed scheme irrigated by the river Nile in the study area of North Sudan. Fifty two soil profiles, morphologically described and analysed for physical and chemical characteristics, were selected for the statistical analyses of this study.

The studied soil characteristics were:

- Soil salinity (EC_e) expressed in dS m^{-1} of the extract of the saturated soil paste.
- Soil sodicity expressed in ESP and SAR.
  ESP = Exchangeable Sodium Percentage = percentage of sodium of all exchangeable cations.
  SAR = Sodium Adsorption Ratio = $[\mathrm{Na}]/[\mathrm{Ca}+\mathrm{Mg}]/2)^{0.5}$.
- Textural classes expressed in sand, silt and clay (percent by weight).
- Cation exchange capacity (CEC) expressed in cmol (+) kg^{-1}.
- Soil reaction expressed in pH (pH of paste extract, same extract as used for soil salinity determination).
- Available phosphorus (P Olsen) expressed in mg kg^{-1}.
- Soil bulk density (BD) expressed in g cm^{-3}.
- Available water capacity (AWC) expressed in cm in top one meter.

Each soil characteristic was determined for the 52 soil profiles for 0-30 and 30-90 cm soil depths, denoted by D1 and D2, respectively. The methods used for chemical and physical analyses are those proposed by the Land and Water Research Centre of Sudan which were adapted from RYAN *et al.* (1996).

The multiple and pairwise correlations for different soil properties were obtained by using JMP 5.1 software (SAS INSTITUTE, 2000).

3 Results and discussion

In Table 1, physical and chemical characteristics of the soils from the 52 profiles are shown. Table 2 shows the correlations between different properties of the studied soils.

Table 1: Physico-chemical characteristics of the 52 studied soil profiles.

	0-30 cm soil depth (D1)		*30-90 cm soil depth (D2)*	
	Range	*Mean*	*Range*	*Mean*
$CaCO_3$ (%)	0-13.4	2.53	0-14	2.83
Sand (%)	31-96	65.39	30-90	52.69
Silt (%)	3.0-40	18.95	0-45	22.88
Clay (%)	1.00-39	15.18	5.0-34	20.48
CEC (cmol (+) kg^{-1})	5.0-32	14.38	7.0-38	19
pH (paste)	7.2-8.3	7.87	6.5-8.4	7.61
Avail. P (Olsen) (mg kg^{-1})	0.3-3.6	1.65	0.2-3	1.41
SAR	1.00-33	4.95	1.00-83	9.49
ESP	1.00-40	7.21	1.00-89	11.57
EC_e (dSm^{-1} at 25 °C)	0-27	2.84	0-33	5.03
Bulk density (gcm^{-3})	1.7-2.04	1.88	1.69-2.02	1.86

3.1 Texture and Cation Exchange Capacity

Looking at Table 2 together with Fig. 1a & b and 2a & b, it is obvious that the CEC is highly correlated not only to clay but also to silt at 0-30 and 30-90 cm soil depth, indicating a considerable contribution of the silt fraction to the colloidal activity.

Since a colloid is defined as having a spherical radius smaller than 1μm (VAN OLVEN, 1977), the explanation of the source of negative charge (colloidal activity) of silt may be related to the aggregation of fine clay particles known as pseudo-silt. This is in line with VITROINO and TADAEU FERRIA (2003) who found an increase in colloidal negative charge of silt-size aggregates of tropical soils from Brazil.

In a recent study PIO (2006) found a significant correlation of CEC with silt and clay for soil series of Northern Sudan. Moreover, mineralogical studies revealed smectitic constituents of the silt fraction of soils under comparable conditions (AHMED, 2002). These three layer clay minerals contribute to the negative charge in silt-like particles. These findings are important to be considered when the colloidal behavior of tropical soils is under question (see also ELGABALY and KHADR (1962); MORRAS (1995).

The correlations presented in Table 2 show a high significant negative correlation between sand and CEC in contrast to silt and clay. Because of their absence of negative charges, sand particles do not contribute to the colloidal complex. For this reason, if we deal with cultivation of sand and loamy sand soils, application of organic manure is essential to improve CEC and soil moisture conditions (ASADU *et al.*, 1997; PEINEMANN *et al.*, 2000). The content of organic matter of the soils in North Sudan is very low (<1%). In the past, soils of this region were evaluated as low fertility soils because of their low clay content and low colloidal activity. However, the contribution of the silt size particles to the colloidal complex as in the present study may add to improve the interpretation of the soil fertility status of such soils. This silt fraction is not only advantageous to soil fertility, but it is also imparted as improving the water holding capacity and therefore the available water capacity (AWC, Table 2).

Table 2: Correlations between different properties of the studied soils (calcium carbonate, sand, silt, clay, cation exchange capacity, pH of paste extract, phosphorus (Olsen), sodium adsorption ratio, exchangeable sodium percentage, electric conductivity of the extract, bulk density and available water capacity)

$\longrightarrow$ **Depth 30-90cm**

	$CaCO_3$	*Sand%*	*Silt%*	*Clay%*	*CEC*	pH_e	P_{Olsen}	*SAR*	*ESP*	EC_e	*BD*
$CaCO_3$		0.0274	- 0.0189	0.0468	0.0228	-0.1735*	0.0439	-0.0144	-0.0230	0.1767	0.1525
Sand%	-0.0956		-0.7723***	-0.7399***	-0.7398***	-0.0975	-0.1555	-0.1049	-0.0884	-0.1708	-0.2561
Silt%	0.0869	-0.8823***		0.2821	0.4105**	0.1764	0.1995	0.0881	0.0781	0.0567	0.0058
Clay%	0.1036	-0.8395***	0.5479***		0.7804***	0.0269	0.0530	0.1224	0.1165	0.2364*	0.3875*
CEC	0.1101	-0.7266***	0.5257***	0.7987***		0.0764	-0.0091	0.1305	0.1024	0.1977	0.1663
pH_e	-0.1300	0.0142	-0.0153	-0.0407	0.0591		-0.1725	0.1655	0.1353	-0.0898	-0.0049
P_{Olsen}	0.3501**	-0.2579	0.2977*	0.1519	0.1708	-0.0002		0.1849	0.2086	0.2501	-0.0493
SAR	0.2574	-0.3264*	0.2538	0.3470*	0.2785	-0.0126	0.2827		0.9851***	0.6990***	0.0491
ESP	0.2511	-0.3311*	0.2377	0.3698**	0.2364	0.0032	0.2537	0.9486***		0.6802***	0.0680
EC_e	0.2147	-0.1399	0.0737	0.1947	0.1265	-0.2343	0.1147	0.7940***	0.7135***		0.1864
BD	0.1989	-0.1641	0.1933	0.0931	0.1165	-0.0569	0.0776	0.3199	0.2789	0.2963	
AWC	-0.2437	-0.3640	0.3641*	0.2905*	0.1514	-0.0517	0.2350	0.0769	0.0842	-0.0558	0.1862

Depth 30-90cm $\longleftarrow$

Note: *, **, *** stand for significant at $P < 0.05$, $P < 0.01$ and $P < 0.001$ level, respectively

Figure 1: Pairwise correlations between different soil characteristics (depth 0-30 cm)

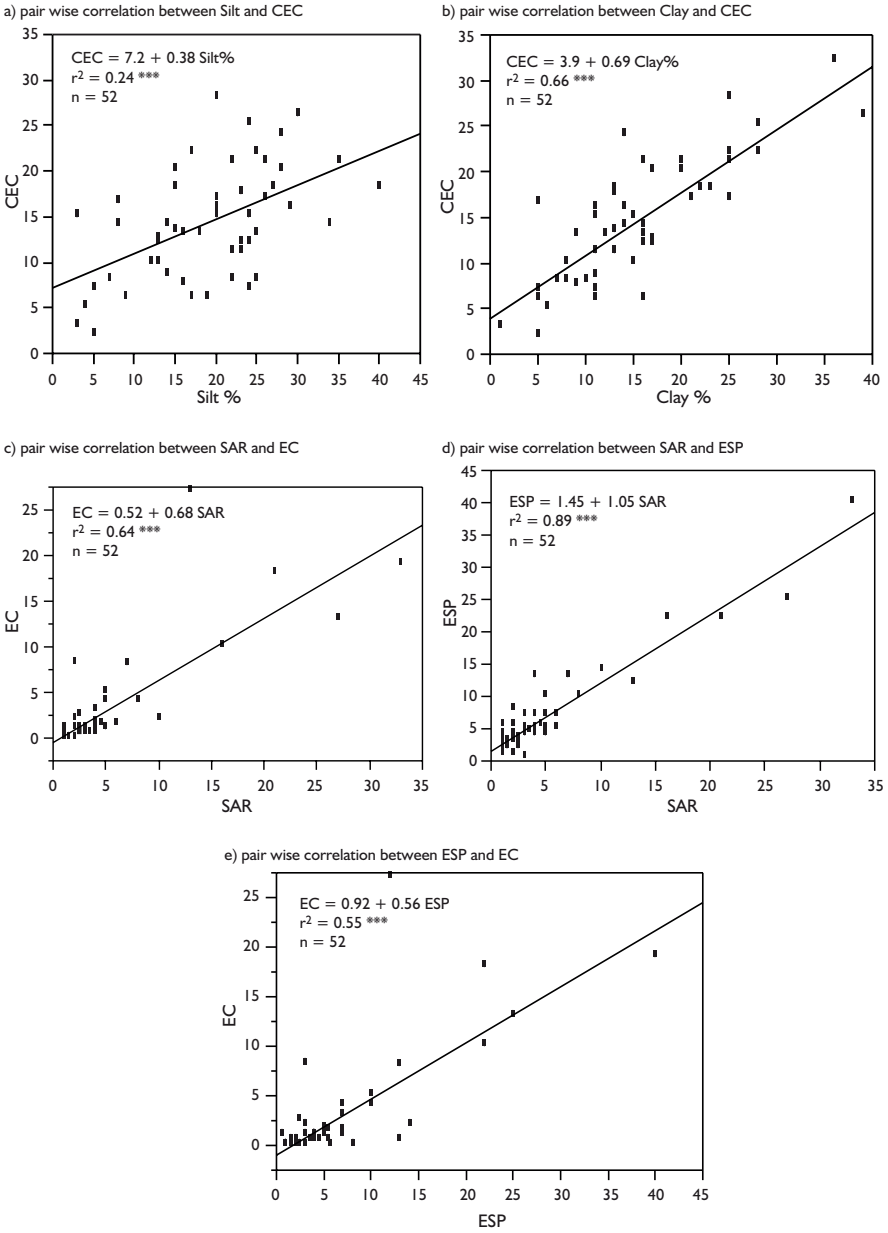
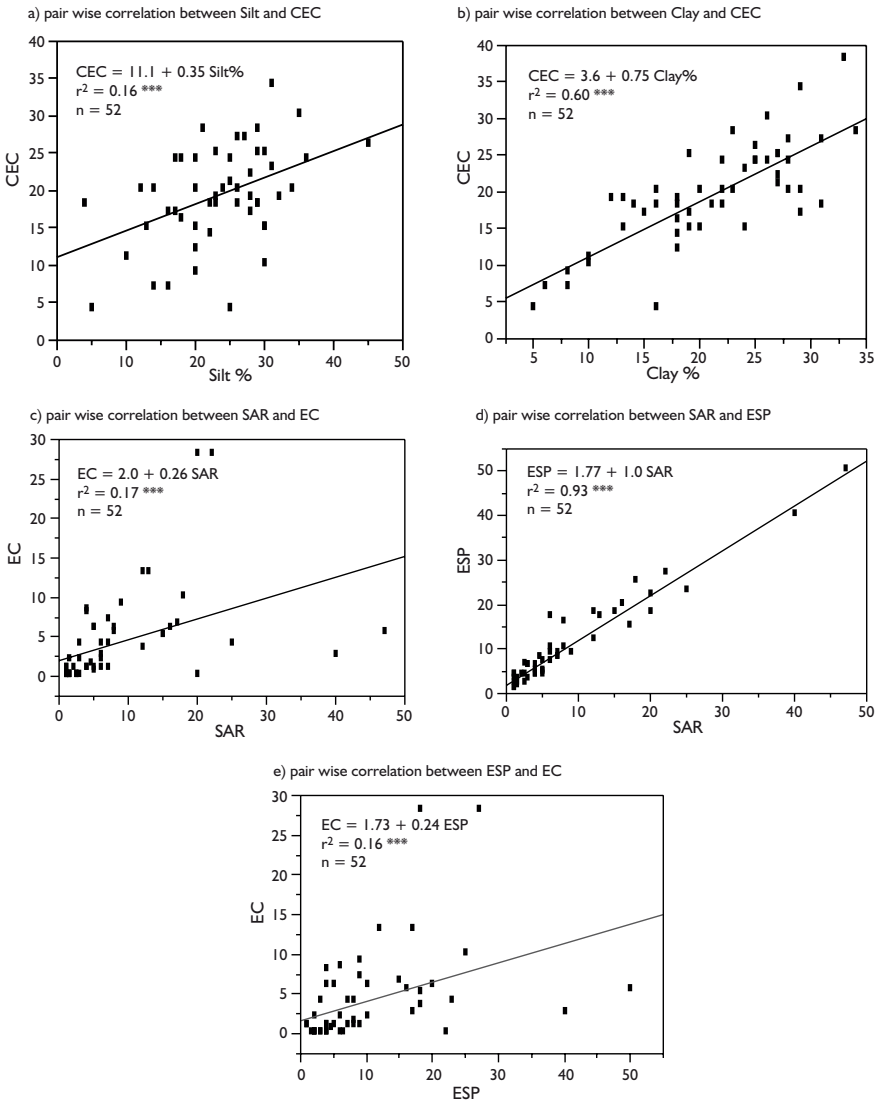


Figure 2: Pairwise correlations between different soil characteristics (depth 30-90 cm)



3.2 Salinity and Sodicity

Most of the soils in the investigation area were reported to be salt affected soils in many previous reconnaissance studies (HTS and MMP, 1965), but the chemical data that were used for these studies revealed that more than 90% of the tested samples had an EC_e(dS m^{-1}) and an ESP of less than 4 and 15, respectively.

Salinity and sodicity are separate and unique descriptions of the impact of soluble salts in soil and water. Sodicity represents the relative predominance of exchangeable sodium compared to other exchangeable cations, chiefly calcium, magnesium, potassium, hydrogen and aluminium and is expressed as ESP (exchangeable sodium percentage). The sodium adsorption ratio, SAR, is another expression of sodicity that refers to the ratio of adsorbed sodium and the sum of calcium and magnesium. Soil salinity is a characteristic of soils relating to their content of water-soluble salts and expressed mostly as EC_e (electrical conductivity of paste extract) and is measured as dS m^{-1} (Charman and Murphy, 2000). The inter-relation of all these soil parameters is important for the interpretation of their measures (van de Graaff and Patterson, 2001).

In the present study, multiple and pairwise correlations have been calculated between different soil parameters (Table 2) and between ESP, EC, and SAR (Fig.1c, 1d, 1e & 2c, 2d, 2e). There are high positive correlations between EC, ESP and SAR indicating a strong association of salinity with sodicity in the investigated soils. Association of salinity with sodicity in the study area was also observed in most of the soil surveys of the region which revealed many saline-sodic mapping units (Buramha, 1998).

Results in Fig. 1d and Fig. 2d confirm the highly significant correlation between SAR and ESP in both soil depths. Since both SAR and ESP are expressions of the level of sodicity, this finding may help to estimate ESP using SAR data. The estimation of ESP using SAR data is based on the fact that the exchangeable reactions take place between the soil solution and the exchange surface of the soil. Analytically, it is much easier to determine SAR instead of ESP. This topic was already discussed by several authors (USSL Staff, 1954; Rengasamy *et al.*, 1984; Elhagwa, 1989). Recent findings of correlation between SAR and ESP are described by Kopittke *et al.* (2006) and by Ganjegunte and Vance (2006). The results of our study revealed the following relations (Fig. 1d and 2d):

$$ESP = 1.45 + 1.05\,SAR \quad (\text{for } 0 - 30\,\text{cm soil depth}) \tag{1}$$

$$ESP = 1.77 + 1.0\,SAR \quad (\text{for } 30 - 90\,\text{cm soil depth}) \tag{2}$$

4 Conclusions

From our findings we conclude that:

(1) The silt fraction of the studied soils contributes to the negative charge of the exchange complex.

(2) There is a salinity-sodicity association in the studied desert soils.

(3) The proposed formula allow to calculate ESP using SAR data in the studied Sudanese soils.

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Fruticultura orgánica en el trópico: Situación y ejemplos de Mesoamérica

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Resumen

La situación en la fruticultura orgánica de Mesoamérica no es fácil a cualificar y cuantificar. Indudablemente existen áreas certificadas sin embargo faltan datos exactos. En otra manera muchos campesinos cultivan frutas y vegetales sin el uso de fertilizantes inorgánicos y sin aplicaciones de pesticidazas por falta de insumos propios. Este estudio esta basado en ejemplos y practicas conocidas y trata a reflejar filosofías practicas del campesinado y las fortalezas y debilidades correspondientes. De lo mas énfasis se ha dedicado al chayote en Costa Rica y México, a la pitahaya en Nicaragua, a la papaya en el Estado Tabasco y al mango, rambutan y caña de azúcar en el estado Chiapas, México, y a las huertas familiares en Cuba. Resultados de una encuesta entre consumidores reflejan el interés para consumir productos orgánicos, establecer la interacción agricultores-consumidores como parte del proceso de desarrollo agroecológico y fortalecer la educación de los consumidores y productores en los aspectos agroecológicos y de salud.

Palabras Clave: fruticultura orgánica, Mesoamérica, chayote, pitahaya, papaya, mango, rambutan, caña de azúcar, huertas familiares, Costa Rica, México, Nicaragua, Cuba

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1 Introducción

La agricultura orgánica ha pasado en la última década un desarrollo impresionante. Esto es producto a nuevos y diferentes retos más allá de una tarea estrictamente productora y proveedora de alimentos y materias primas, que se manifestaba como dominante en los siglos anteriores (Flórez Droop, 2007; UNCTAD, 2003). Sin embargo todavía existe la opinión, que mediante la agricultura orgánica no es posible producir las cantidades de alimentos que solicitan específicamente las regiones tropicales con sus poblaciones altas y desnutridas, y esto se debe respaldar en cierta manera (Janssens *et al.*, 2004).

Indudablemente es una verdad, que de igual modo como en Europa, los Estados Unidos y Japón la agricultura orgánica en el trópico presenta actividades agrarias que buscan la obtención de alimentos, forrajes y materia prima de calidad en tal manera, que existe calidad organoléptica, calidad sanitaria y calidad en los procesos productivos respecto al medio ambiente (Garibay, 2007; Freyre y Pérez, 2001; Pohlan, 2001).

Las estadísticas sobre el área de cultivo y el volumen del mercado presentan sin duda las grandes diferencias entre los países que están encabezando este desarrollo y la mayoría de los países en el trópico (Willer, 2001). También es bien conocido que grandes extensiones como en Australia y Argentina todavía no determinan una participación exitosa en el mercado internacional. En Argentina ha aumentado el área con producción orgánica desde el año 1990 con 5.500 ha hasta 3 Millones hectáreas en el año 2000. Esto se debe en particular por la incorporación de pastizales con la ganadería bovina y ovina extensiva. La gran mayoría de los estados latinoamericanos todavía esta en arrancar siembras orgánicas. Claro que si, es un éxito para Brasil ya tener 100.000 ha, sin embargo esto solamente son 0.04 % del área agrícola total de este país. Con excepción de Costa Rica (0.34 %), todos los países de América Latina no alcanzan 0.1 % con cultivos orgánicos certificados. Para la horticultura mesoamericana no existen cifras confiables, sin embargo es una verdad que la agricultura cubana hoy en día, por falta de insumos químicos, esta basada en un muy alto por ciento únicamente en manejos agroecológicos orgánicos (Leyva Galán y Pohlan, 2005).

El intenso crecimiento de las ventas de alimentos orgánicos, ha desarrollado un nicho de mercado viable y con un valor agregado. En este incremento han contribuido los cambios en los hábitos alimentarios de muchos sectores de la población de los países desarrollados a raíz de una mayor conciencia del aspecto sanitario de la alimentación, esto ha provocado una creciente solicitud de una variedad más amplia de productos, incluyendo a los frutos y hortalizas los cuales son demandados por los consumidores en los mercados internacionales.

2 Situación y tendencias en Mesoamérica

Las regiones tropicales, y en particular sus regiones con condiciones marginales constituyen ecosistemas típicos con hábitats diversificados para una alta biodiversidad floral y fauna variada. Uno de los sueños más grandes del hombre embarca el mantenimiento de riquezas en flora y fauna. Sin embargo en el mismo momento le sale la inquietud, la necesidad y la avidez de aprovechar y dominar cualquier pedazo de nuestro globo.

Así existe una contradicción fuerte entre los objetivos de rescatar, revalorizar y promover costumbres y tradiciones de cada pueblo y la necesidad de aumentar la productividad y mejorar la calidad de productos agropecuarios (Huber, 2007; Pohlan, 2006; Geier, 1998).

La situación general en Mesoamérica es así, que no hay abundancia en sistemas dirigidos directamente al cultivo orgánico de frutales y hortalizas asimismo como la cría de animales. Sin embargo ya hay primeros ejemplos y la idea esta prosperando. Esto esta incitando una disposición y dinámica del paradigma entre los sistemas tradicionales, desarrollados por los pequeños productores, y las grandes extensiones con cultivos únicos o en monocultivo. Fundamental para todos ellos es la búsqueda de generar un desarrollo ecológico a través de un cambio en la producción agropecuaria y la transformación de diferentes sistemas de cultivos, incluyendo los diferentes niveles e interacciones económicas, ecológicas y sociales. Así será posible utilizar la naturaleza sin romper sus ciclos biológicos y despertar las riquezas de flora y fauna para modelar un patio grande en armonía con los requisitos de la sostenibilidad (Pohlan *et al.*, 2005).

Las nuevas exigencias para la vida humana en general y de los países importadores de frutas exóticas, especias tropicales y plantas medicinales en especial, en cuanto a residuos o contaminantes en estos productos, colocan para el futuro a la producción orgánica como una de las mejores alternativas para un verdadero desarrollo sostenible en el trópico de Mesoamérica. Por esto es importante destacar, que los pequeños productores así mismo como las grandes empresas transnacionales están competiendo en el desarrollo de alternativas a favor de una agricultura orgánica. Lo importante de producir productos sanos es, que esto garantiza para el futuro una recuperación de las áreas de producción convencional en cuanto: al medio ambiente, a la biodiversidad, a la productividad y al final a la calidad de vida y la sobrevivencia de las zonas rurales.

El gran desafío que tenemos por esta situación antes mencionada es la necesidad de transformar los sistemas del cultivo convencional a favor de sistemas ecológicos y sostenibles. Esto es un proceso innegable y necesario. Específicamente la situación socioeconómica desfavorable para los productores, pero también la falta de iniciativas y creatividad así mismo como el bajo nivel en la educación profesional han frenado en cierta manera actividades enérgicas en la formación de nuevas estructuras agroecológicas en las regiones tropicales. Una oferta interesante y de múltiple importancia podrán ser sistemas de la agricultura orgánica depende de las condiciones edafo-climáticas, del gusto y de la experiencia teórica - práctica de los productores, de las oportunidades comerciales en la región y para la exportación y de las opciones en el procesamiento, entre otros (Lernoud, 2001; Pohlan, 2001; Mejía Gutiérrez, 1999).

La situación actual en Mesoamérica carece de intercambios prácticos y teóricos entre todos los interesados en una agricultura orgánica y por esto faltan conocimientos amplios en cuanto a los requisitos obligatorios y facultativos en un desarrollo sostenible de este rubro trascendental, amplio y diverso de las zonas frutícolas.

Los puntos de mayor interés son:

- oportunidades y obstáculos para la transformación de los sistemas convencionales existentes a sistemas agroecológicas económicamente, ecológicamente y socialmente sostenibles;
- la certificación ecológica y la validación de nuevos sistemas;
- la capitalización de la producción orgánica;
- el conocimiento de las condiciones edafo – climáticas y su establecimiento y explotación correcta en conjunto con cultivos interesantes para la comercialización;
- el manejo bajo las buenas practicas de los cultivos;
- el mantenimiento de la calidad de los productos en pre- y postcosecha;
- la cadena de valor agregado desde el productor al mercado, pensamientos y experiencias locales, regionales y de exportación.

3 Oportunidades y obstáculos

Esta amplia problemática ya ha sido objeto de un sinnúmero grande de publicaciones (Altieri, 2006; Leyva Galán y Pohlan, 2005; Cáceres, 2003). Por buena suerte estas no han fundamentado solamente discusiones y escritos académicas o políticas. Ejemplos de diferentes países y regiones tropicales nos muestran la firmeza y vitalidad que han alcanzado proyectos de desarrollo rural sostenible, pero también están demostrando la multitud de obstáculos que han cerrado los caminos.

El hombre mismo es el punto clave en este proceso. Apoderar a los campesinos, liberarse de sus propios límites, como pesimismo, tradicionalismo, autocomplacencia, y valerse de sus talentos y experiencias sea un paso más adelante. Esto significa abrirse a la capacitación, a la creatividad y al manejo empresarial. El entendimiento, la aceptación y el aprovechamiento de las interacciones presentes en la sostenibilidad son básicos para un camino exitoso.

En América Latina la agricultura orgánica en su mayoría todavía esta buscando sostenibilidad, pero no obstante, en esta refleja muchas contradicciones y así es un magnifico espejo para visualizar oportunidades y obstáculos en el progreso de sistemas orgánicos sostenibles. Los aspectos más comunes e importantes ofrece el cuadro 1.

4 El chayote (*Sechium edule* /Jacq./ Sw.) y sus perspectivas en el cultivo orgánico

Costa Rica, es el principal exportador a nivel mundial del chayote convencional, cuyas frutas son de color verde claro y con una pulpa poca consistente, sin embargo, no ha desarrollado la producción a escala del chayote orgánico, esto coloca ha este país en desventaja competitiva en cuanto a la comercialización del chayote orgánico. Lo antes mencionado se debe a que, actualmente en el Sur de México se esta desarrollando un proyecto de producción orgánica de chayote MAM (Maya), el cual es originario del sur de México y norte de Guatemala el mismo es un ecotipo de la especie *Sechium edule*. El chayote MAM se caracteriza por poseer una pulpa consistente, sabor agradable y un color de la epidermis verde oscuro. Estas particulares de este chayote le permiten

Cuadro 1: Oportunidades y obstáculos principales para una agricultura orgánica en Mesoamérica

Oportunidades	Obstáculos
* La inspección y certificación de áreas ya se ha practicado en diferentes áreas	+ Las nuevas exigencias de los países importadores, en cuanto de un cumplimiento absoluto de las normas externas
* Los campesinos y productores tienen voluntad, interés y conciencia para cultivar en manera orgánica	+ El grado de dominio teórico - práctico de la agricultura orgánica y de cultivos y rubros nuevos
* Muchas áreas agrícolas necesitan el rescate de su fertilidad y productividad	+ La falta de estudios sobre la adaptabilidad de especies y variedades a las condiciones ecológicas de cada región
* La presencia de una ganadería mayor y menor tradicional y extensiva	+ La falta de costumbres y conocimientos en manejar sistemas integrales en manera regional
* El mercado internacional presenta condiciones admirables para productos orgánicos frescos y procesados	+ La carencia de volúmenes mínimas con calidad certificada de los productos requeridos y la ausencia de capacidades para el procesamiento
* La alimentación latina necesita un cambio imprevisto a favor de hortalizas y frutas sanas	+ El bajo nivel económico y social de una gran parte de las poblaciones
* Las perspectivas grandes en el aumento de la comercialización regional, nacional e internacional de un numero mucho más grande de cultivos y sus productos	+ La desconfianza en el poder económico y en la disciplina fiscal de los campesinos y productores en el sector agropecuario
* La vida actual en zonas rurales no cumple las necesidades mínimas	+ La indecisión a favor de procesos nuevos y el aumento de una pobreza rural

obtener un excelente precio en los mercados internacionales y nacionales. Además, la gran mayoría de las organizaciones mayas producen el chayote MAM con prácticas y principios orgánicos. Este hecho es de suma importancia porque los indígenas mayas del sur de México serian los primeros en comercializar el chayote orgánico a nivel mundial.

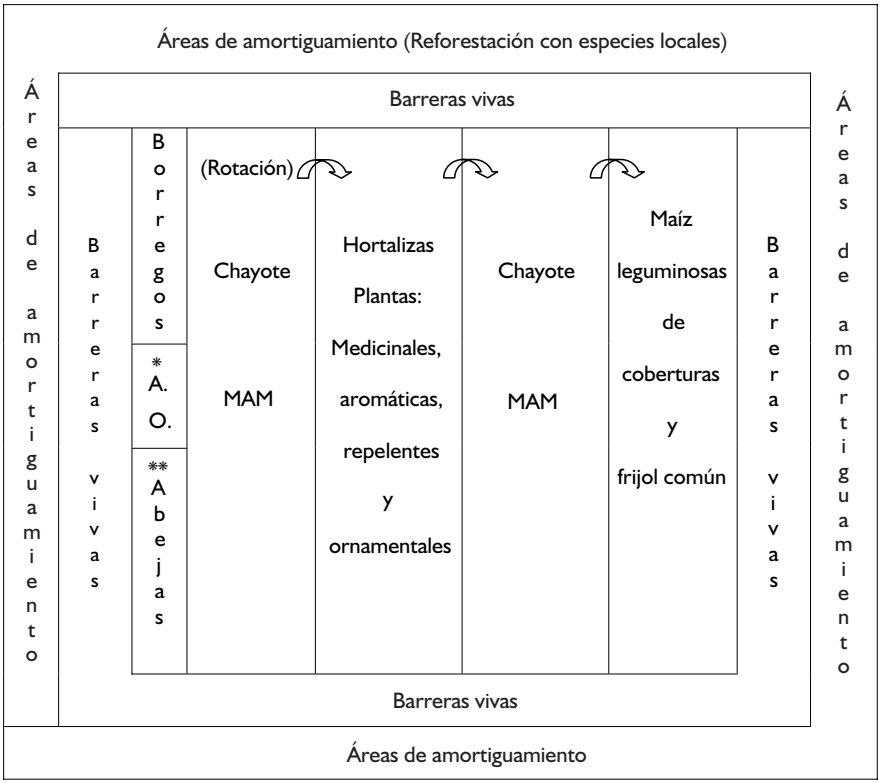
Por otro lado el desarrollo del chayote MAM da la oportunidad para aprovechar todas las ventajas que genera esta actividad en la investigación y producción para mejorar las condiciones sociales, económicas, ecológicas y culturales que constituyen las razones suficientes para su promoción y fomento en las regiones de la Sierra Madre y el Soconusco, Estado de Chiapas.

4.1 Principios y prácticas

Los enfoques sobre los principios y prácticas de la producción del chayote orgánico están fundamentados en la base social, económica, ecológica y cultural (Gamboa, 2005). Por eso los principios que se considera en el desarrollo de este cultivo son a nivel ecológico:

La integración del manejo fitosanitario(Ecología de las plagas), sistemas integrados de nutrición de las plantas (Ecología de las plantas), conservación y mejoramiento de las características físicas, químicas y biológicas del suelo (Ecología del suelo), la diversificación vertical y horizontal, integración planta-animal, la provisión de una fruta saludable y de alta calidad nutritiva, reciclaje de materiales de la propia finca y región, organización de la finca como sistema, uso de coberturas, mantenimiento de la biodiversidad dentro y en el entorno de la propiedad, protección de la vegetación, el hábitat y la vida silvestre entre otros (figura 1)

Figura 1: Esquema del jardín chayote MAM. * Abono orgánico, **Abejas distribuidas alrededor del sistema



A nivel socioeconómico estos sistemas mejoran la situación de los indígenas por medio de la generación de empleos y la comercialización del chayote MAM en el mercado globalizado y desde el punto de vista sociocultural, se enfatiza en que los consumidores, productores y sus familias son constructores de una riqueza y para ello no pueden ni deben pagar con su salud.

Para desarrollar la producción de chayote bajo un sistema agroecológico es importante impulsar las siguientes prácticas:

⇒ Conseguir ciclos más cerrados de nutrientes para mantener la fertilidad del suelo a través del uso de abonos orgánicos, biofertilizantes y verdes, con la implementación de prácticas culturales apropiadas como la rotación y diversificación productiva y uso de coberturas vivas y muertas.

⇒ Fomentar la diversificación y la biodiversidad para mantener una producción sostenible incluyendo la integración animal-forestal y la conservación de la diversidad genética del chayote MAM.

Esto requiere los siguientes pasos principales:

▷ Producir en base a los recursos locales;

▷ Fortalecer los mecanismos naturales y de autorregulación;

▷ Llevar a cabo la protección de plantas en base de medidas preventivas y ecológicas;

▷ Aplicación de medios naturales para el procesamiento de los productos agrícolas;

▷ Producir alimentos naturales y completos, garantizando una nutrición sana a los consumidores;

▷ Conservación del agua, suelo y entorno natural;

▷ Comercializar en el mercado equitativo.

4.2 Avances en la producción del chayote orgánico en Costa Rica

En Costa Rica en el Valle de Ujarrás, los agroecosistemas de chayote se han vuelto muy frágiles. Esta perturbación ha incrementado las enfermedades y plagas que están afectando el rendimiento principalmente, el de exportación. Lo anterior obliga a buscar posibilidades para sustituir, paulatinamente, no solo variedades si no sistemas de manejo que sean alternativas para el cultivo de chayote. Por eso se desarrolló la investigación de la producción orgánica del chayote. Las parcelas donde se instauró el chayote orgánico estaban rodeadas de barreras vivas conformadas por plantas aromáticas, medicinales y relentes y de áreas de amortiguamiento con el pino (*Pinus caribea* Morel.)

El terreno donde se estableció el chayote alternativo se preparo con la chapia de las arvenses las cuales se dejaron como cobertura y para desinfectar el suelo se uso Kilol (*Citrus paradisi* Macf.). Por ciclo se aplico 16 t/ha del abono orgánico como la gallinaza, cerdaza, compost y bocashi. La fertilización foliar se realizo de forma alterna, con la utilización de la miel de purga, los foliares a base de hierbas, frutas y melaza y un biofertilizante hecho de estiércol de boñiga. El manejo de plagas y enfermedades se efectuó de forma alterna con extracto de: la cebolla (*Allium cepa* L.), el jugo de ajo (*A. sativum* L.), el chile picante (*Capsicum annuum* L.), el apazote (*Chenopodium ambrosioides* L.) mas ajo. También se aplico los extractos botánicos con base a el hombre grande (*Quassia amara* L.), el madero negro (*Gliricidia sepium* /Jacq./ Steud) y la gavilana (*Neurolaena lobata* L.). También se empleo *Bacillus thuringiensis* para el manejo del gusano perforador y ácaros, estos últimos insectos se redujeron con la aplicación de humedad en el follaje lo que provoco un cambio en el hábitat del acaro.

El manejo de las arvenses se efectuó de forma manual y las adventicias que se cortaron se colocaron en el suelo como mulch. Además, algunas especies de arvenses se dejaron como repelentes o atrayentes de insectos.

Es importante destacar que los insumos energéticos utilizados en la producción orgánica de chayote se obtuvieron básicamente de fuentes renovables lo que representa casi el 99 por ciento del total de los .insumos energéticos aplicados en estas parcelas. También dentro de la estrategia para la producción orgánica se impulso la diversificación productiva por medio de la asociación y rotación de cultivos. Algunos de los cultivos utilizados fueron: Chayote-maíz-vainica, chayote-frijol verde-apio, chayote-cebollín: (*Allium schoenoprasum* L.), arveja china (*Pisum sativum* L.) y berenjena (*Solanum melongena* L.). El manejo orgánico del chayote junto al diseño establecidas en la parcela orgánica, contribuyeron a reducir las plagas y las enfermedades, especialmente la incidencia de Ascochyta (*Ascochyta phaseolorum* Sacc.), una de las enfermedades que provoca la mayor perdida de frutas de chayote de exportación. A pesar, de que se encontró un incremento de la phoma y de los insectos dañinos en la producción orgánica, estos no fueron tan elevados al compararlos con el uso de los agroquímicos empleados en la parcela convencional.

En cuanto a los rendimientos se encontró una mayor estabilidad de la producción bajo el sistema orgánico. En el primer ciclo de producción, el rendimiento de exportación que se logró en la parcela convencional fue de 95,4 t/ha y en la orgánica de 89.5 t/ha. Sin embargo, en el período, 1993-94, la producción de frutas de exportación de las plantas con el manejo no orgánico se redujeron a 74.7 t/ha y con los productos orgánicos el rendimiento se conservó similar al alcanzado en la época anterior con 87 t/ha.

4.3 Producción orgánica de chayote MAM

En casi toda la región de la Sierra Madre el chayote MAN se encuentra disperso en áreas pequeñas. Esta permanencia del chayote en estos lugares junto a las características culturales que los indígenas y agricultores le han dado, permite no solo que esta especie se distribuya y adapte a una gran variabilidad de ambientes, sino que genera una amplia diversidad genética que se manifiesta en la forma tamaño, color y sabor de la fruta de chayote producida bajo estas condiciones.

El manejo orgánico que le otorgan los indígenas mayas a este cultivo se fundamenta prácticamente en el reciclaje de nutrientes de la finca. Este manejo consiste en la aplicación ocasionalmente de abono orgánico el cual es fabricado con el estiércol de borrego, los rastrojos de maíz, residuos de arvenses, pulpa de café entre otros, no obstante estos abonos no son suficientes para el suelo debido a la baja fertilidad y humedad que existe en la región de la Sierra Madre. Para el manejo fitosanitario solamente aplican chile picante más ajo. Sin embargo este sistema agroecológico es de subsistencia y difícilmente las frutas de chayote MAM producidas bajo esas condiciones de producción van a tener la calidad necesaria para abastecer y competir en los mercados nacionales e internacionales.

Por eso se requiere desarrollar en la región con los minifundios que actualmente están producción el chayote MAM, una agricultura agroecológica de mercado orientada hacia

los actividades comerciales nacionales e internacionales, es decir que es primordial promover un chayote orgánico a prueba de mercado y certificado para lo cual es necesario considerar y producir frutas de chayote MAM de alta calidad.

Por esa razón se esta desarrollando un proyecto de producción orgánica de chayote MAM en la región de la Sierra Madre y el Soconusco, el mismo se fundamenta en los principios y las practicas que sustentan la agricultura orgánica, Además en este proyecto se incluye el desarrollo de fincas integrales en diferentes localidades, las mismas contemplan la biodiversidad, la diversificación productiva, reforestación conservación fertilidad, biología del suelo, la conservación de la diversidad genética del chayote MAM y con una mayor eficiencia del uso de los recursos de la finca y de la región Asimismo estas parcelas funcionaran para la capacitación y transferencia de conocimientos hacia los productores dispersos y que estén cultivando el chayote MAM.

5 El cultivo orgánico de la pitahaya (*Hylocereus undatus* Britton & Rose) en Nicaragua

La pitahaya es una planta que pertenece a la familia *Cactaceae*. Generalmente las cactáceas son plantas suculentas, sin hojas y con muchas espinas (caracteres xerofíticos) y se adaptan bien en zonas secas y áridas. Este cactus es una planta epifita y originaria de América, se encuentra en forma silvestre en Colombia, Guatemala, México, Nicaragua y Curaçao. A nivel comercial hay dos especies de pitahaya. La especie *Cereus triangularis* Haw., conocida como pitahaya amarilla, que se siembra en Colombia y la especie *Hylocereus undatus*, cuya pulpa es de color rojo intenso hasta morado, que es la que se cultiva en Nicaragua, el sur de México, Guatemala y El Salvador (López *et al.*, 2004).

En América latina, el cultivo de la pitahaya roja (fruta escamosa) en buena medida sigue siendo tradicional, principalmente en huertos familiares y superficies pequeñas (Meráz Alvarado *et al.*, 2003). Sin embargo, sus frutos exquisitos tienen amplia demanda en mercados regionales y son apreciados y demandados como fruta exótica en el mercado internacional. El cultivo especializado de este cactus está por cumplir 20 años, por lo que en el ámbito mundial aún se trata de un cultivo nuevo. No obstante, en tan poco tiempo ya se ha generado información básica acerca de sus características como planta, así como importantes experiencias en su manejo como cultivo y en la comercialización de sus frutas (Rodríguez, 2000). Como cultivo especializado existe en varios países del continente americano (Nicaragua, México, Guatemala y El Salvador), y de otros continentes (Italia, Israel, Vietnam, Taiwán y Hong Kong). En Centro América, Nicaragua y Guatemala han incursionado en el mercado internacional de frutas frescas exóticas, y el primer país también lo comercializa en forma de fruta congelada a Estados Unidos por sospecharse que es hospedera de la mosca de la fruta.

En Nicaragua, la producción especializada de esta fruta la hacen principalmente pequeños productores, quines tienes plantaciones que oscilan entre 0.2 a 2.1 ha. Aunque existen productores con áreas comerciales mayores. Actualmente se han reportado un total de 31.45 ha, cuya producción es de 318 toneladas por año (El Nuevo Diario, 2006). Los dos primeros años se puede cultivar asociada con cultivos anuales y semiperennes (fríjol, tomate, chile dulce, rábano, abonos verdes y piña). En fincas orgánicas

certificadas se ha introducido el cultivo de esta fruta escamosa como parte de la diversificación del agroecosistema, pero su producción es exigua para exportarse y por consiguiente se comercializa en el mercado nacional como una fruta procedente de una plantación convencional.

Las prácticas de cultivo orgánico se basan en una reproducción en forma sexual y asexual. Las plantas provenientes de semillas tienen un crecimiento lento y el inicio de la floración es muy tardado (hasta siete años para producir). Generalmente, la vaina o tallo es el material más usado para establecer plantaciones comerciales, ya que las plantas presentan un mayor crecimiento y desarrollo. Para el establecimiento de la plantación se realizan las siguientes labores: Limpieza y preparación del terreno, trazado de los surcos en curvas de nivel y estaquillado, hoyado del terreno y el establecimiento o siembra de los tutores. El uso de los tutores en el cultivo de la pitahaya es indispensable, pues facilita el crecimiento y desarrollo de la planta sirviendo de sostén. Los "tutores muertos" pueden ser postes de concretos, troncos de árboles secos (Madero negro: *Gliricidia sepium*; Quebrancho: *Lysiloma* spp. y Guachipilín: *Diphysa robinioides* Benth.), túmulos individuales de piedra o muros de piedra. Cálix De Dios y Castillo (2000) expresan que las especies arbóreas más utilizadas como tutores vivos son: Helequeme (*Erythrina* spp.), madero negro (*Gliricidia sepium*), también se pueden usar: jocote (*Spondias purpurea* L.), jiñocuabo, (*Bursera simaruba* L.), jícaro (*Crescentia cujete* L.) o tigüilote (*Cordia dentata* Poiret). Los métodos de siembra pueden ser directos y de transplante. La siembra directa consiste en plantar 2 o 3 vainas, sin raíz, directamente en el suelo, al pie y alrededor de cada tutor, formando un semicírculo. La parte del tallo que se entierra es la parte leñosa, entrenudo donde se hizo el corte. Si se siembra en terreno con pendientes, los tallos se colocan en la parte de arriba del surco amarrados al tutor con mecate o cáscara de *Musaceae* (burrillo). La siembra de transplante consiste en establecer las vainas en bolsas de polietileno de 2 kg para que éstas enraícen. Las bolsas se llenan con una mezcla de tierra, arena y materia orgánica, cuya relación es 40:40:20. En este tipo de siembra el hoyo se hace más grande, 30 cm de diámetro y 40 cm de profundidad.

En Nicaragua se define tres sistemas de siembra: tradicional, semi-tecnificado y tecnificado. En el sistema de siembra tradicional se plantan tutores vivos, cuyo largo oscila entre 1.3 y 1.8 m con un diámetro entre 10 y 15 cm. Las distancias entre hileras son de 4 m y 1.5 m entre plantas. En el sistema de siembra semi-tecnificado las distancias son 3 m entre hileras y 2 m entre planta. La siembra es de transplante y los tutores o soportes que se utilizan son muertos. Este sistema de siembra es el más difundido. En el sistema tecnificado existen diferentes tipos o modalidades de siembra, siendo estos: el de espaldera sencilla, espaldera doble y el tipo telégrafo o T. Un inconveniente que presentan estas modalidades de siembra son los altos costos de inversión inicial, pero presentan la ventaja de tener gran durabilidad. La siembra es de transplante y los tutores que se usan son muertos.

El manejo ecológico del cultivo tiene como objetivo mantener el plantío en buenas condiciones para que de buenas cosechas, durante el mayor número posible de años. Las labores agrícolas que se realizan son: resiembra, reposteo, poda (de formación y

de sanidad) y manejo ecológico de fertilidad del suelo, de arvenses, de plagas y de enfermedades. En las plantaciones se realizan podas tanto al cultivo, como a los tutores vivos, si se usa este tipo de tutor, de lo contrario solamente a las plantas de pitahaya. La poda de formación se hace para eliminar los tallos que se entrecruzan entre las calles o surcos. También para evitar que las vainas choquen unas con otras. La poda de sanidad o limpieza consiste en eliminar los tallos secos y los afectados por plagas y enfermedades, el corte debe hacerse en los entrenudos y todo el material que se corte debe enterrarse a fuera de la plantación. La poda de los tutores vivos se realiza para que no den sobra a la pitahaya, ésta se efectúa cada mes en la época lluviosa, con instrumentos bien afilados y desinfectados, pero sin maltratar los tallos de esta *Cactaceae*.

El manejo ecológico de la fertilidad del suelo consiste en hacer obras de conservación de suelo y agua, establecer abonos verdes y la fertilización orgánica. Los fertilizantes orgánicos se aplican tanto al suelo como sobre las vainas o tallos. A la siembra y al segundo mes de establecido el cultivo se fertiliza con 2 kg por planta de bocashi, compost, estiércol maduro o lombrihumus. A partir del segundo año se hacen dos aplicaciones durante la época lluviosa a razón de 2 a 3 kg por planta.

El manejo ecológico de arvenses generalmente se realiza de forma manual con machete. No obstante, este cultivo crece lento en su etapa inicial y por ello no compite bien con las arvenses, sobre todo durante los dos primeros años de desarrollo. Sin embargo, se pueden establecer cultivos intercalados o asociados durante este período. Las leguminosas que se pueden sembrar entre las hileras son: frijol terciopelo (*Mucuna pruriens* /L./ DC) y frijol caballero (*Dolichos lablab* /L./ Sweet.) y *Cajanus cajan* (L.) Millsp. (López *et al*., 2004).

Las plagas mas importantes son: Chinche pata de hojas o patona (*Leptoglossus zonatus* Dallas). Los adultos y las ninfas succionan la savia de los tallos o vainas provocando manchas y deformaciones, posiblemente transmiten enfermedades fungosas y bacterianas. Zompopos (*Atta* spp.) y hormiga negra (*Solenopsis* spp.). Estas plagas se comen las brácteas u orejas del fruto y dañan las vainas. Reducen la calidad de la fruta y la producción. También atacan a los botones florales, ya que éstos secretan una mielecilla que atrae a estos insectos. Otra es el picudo negro o de la vaina (*Metamasius fareih striatoforatus* Galli), su daño principal lo hace en estado de larva perforando los tallos. El barrenador del tallo (*Maracayia chlorisalis* Walker), la mariposa pone los huevos en el tallo, al nacer la larva, penetra en éste, formando galerías en su interior. También pájaros, ratas e iguanas causan serios daños en la plantación durante la época de producción, son capaces de picotear y comerse gran cantidad de frutos maduros (Salazar y Pohlan, 1999). La pudrición de la pitahaya o bacteriosis es la enfermedad más importante y es causada por la bacteria *Erwinia carotovora* Smith. Su control debe ser preventivo. El ojo de pescado causada por el hongo *Dothiorella* spp., se exterioriza inicialmente como manchas circulares de color café en la superficie de los tallos, en el centro de ésta se observa un punto rojo anaranjado, dando la apariencia de un ojo de pescado. Antracnosis (*Colletotrichum gloesporoides* Penz.) se presenta esencialmente en los frutos y ocasionalmente en las vainas. Mancha del tallo y las vainas, cuyo agente causal es *Alternaria* spp.

Las prácticas de manejo ecológico de plagas y enfermedades que se recomiendan son las siguientes: usar material de siembra de plantaciones y plantas sanas, solarizar el suelo y la arena que se usen como sustrato para enraizar las vainas en las bolsas de polietileno. Desinfectar las herramientas que se utilizan para podar con vinagre al 5 %. Si se tienen tutores vivos deben podarse regularmente, cortar las vainas enfermas para eliminar picudos o barrenadores del tallo y para el manejo de enfermedades causadas por hongos o bacterias. En las heridas causadas por las podas se aplica caldo bordolés u oxicloruro de cobre. Establecer leguminosas entre las hileras para el manejo de las arvenses. Uso de los extractos botánicos NIM 20 o NIM 25, cuyo nombre científico es *Azadirachta indica*, el cual se aplica para el manejo de: chinche pata de hoja, zompopos, hormigas, el barrenador del tallo y enfermedades fungosas (Salazar y Pohlan, 1999). También, para manejo del barrenador del tallo se puede liberar Trichogramma y/o aplicar insecticidas biológicos a base de *Bacillus thuringiensis* o *Beauveria bassiana*. Colocar trampas con trozos de piña para el muestreo y recuento del picudo negro y si es necesario se aplica el hongo entomopatógeno *Beauveria bassiana*. Para el manejo de las hormigas negras y los zompopos la excavación de los hormigueros es la práctica más efectiva, pero también se pueden colocar tierra de otros nidos porque puede actuar como repelente. Las aplicaciones con biofertilizantes foliares para coadyuvar a la nutrición de la plantación se realizan mensualmente a una relación de 2 litros de purín de estiércol o de efluentes diluidos en dieciocho litros de agua. Finalmente es necesario realizar monitoreos periódicos en la plantación.

La cosecha de los frutos normalmente se hace cuando están en estado sazón o pinto. La labor se realiza manualmente con tijeras de podar o bien cuchillos especialmente afilados. El corte se hace en el pedúnculo o tallito que une el fruto con la vaina. Se debe tener cuidado no causar daño al fruto, para no perjudicar su calidad y evitar que en el tallo penetren hongos o bacterias causantes de enfermedades. Se recomienda usar guantes de lona o de cuero para proteger las manos del cortador de las espinas que tienen los tallos. Los frutos deben estar completamente sanos, sin manchas, cicatrices, heridas y picadura de insectos. Estos se clasifican según la forma, el tamaño, el peso y el color. Los frutos se transportan hacia el centro de acopio en cajas plásticas o de cartón, cuyo peso oscila entre 5 y 10 kg. Para su exportación, como fruta fresca, se recomiendan cajas de cartón con un peso neto de 3.5 kg, conteniendo de 9 a 12 frutos (PROEXANT, 2007).

6 Fruticultura orgánica en Chiapas y Tabasco, México

México presenta por su enorme diversidad geográfica y étnicas magnificas condiciones para una fruticultura orgánica, sin embargo hasta ahora predominan fuertemente sistemas con el uso frecuente de insumos químicos (Marroquín Agreda *et al.*, 2007; Schwentesius Rindermann y Gómez, 2002; Pohlan *et al.*, 1997). Especialmente en condiciones tropicales los pequeños productores han desarrollado actividades para empujar el cultivo orgánico de frutales con mayor énfasis a la exportación (Cuadro 2).

La actividad frutícola en Chiapas desempeña una importante fuente generadora de ingresos económicos, ya que los huertos frutícolas aglomera una superficie de 38,554.56 ha,

Cuadro 2: Estimación de la superficie, producción y rendimientos de frutales orgánicos en México

Cultivo	*Superficie (ha)*	*Producción total (t)*	*Rendimiento ($t\,ha^{-1}$)*
Mango	2.075,00	26.332,00	12,69
Naranja	1.850,00	17.039,00	9,21
Papaya	1.171,00	20.551,00	17,55
Banano	826,00	36.740,00	44,48
Flor de Jamaica	540,00	140,00	0,26
Piña	329,00	4.201,00	12,77
Rambután	60,00	900,00	15,00
Litchi	16,00	74,00	4,60

destacando en orden de relevancia por su superficie y producción los cultivos de Mango "cultivar Ataulfo" (19.654 ha), Plátano (15.554 ha), Papaya (1.701 ha), Marañón (717 ha), Rambutan (600 ha) y otras (Vanderlinden *et al.*, 2004; Pérez Romero y Pohlan, 2004; Pohlan *et al.*, 2003). Por el área y, el Soconusco destaca como el Otro cultivo de interés agrícola y comercial es el mango, donde participan en este rubro más de 4,700 productores, convirtiéndose el Soconusco como la principal zona productora de mango "Ataulfo" del país. Chiapas es principal productor de plátano a nivel nacional alcanzando también los rendimientos mas altos (36.56 t/ha^{-1}) y el tercer estado con mayor producción de mango en México (15.1 %). Los huertos de frutas del Soconusco, en su mayoría se encuentran bajo un sistema de manejo intensivo dependientes de altos insumos externos, tales como fertilizantes y pesticidas (Marroquín Agreda *et al.*, 2006).

En el rubro de la fruticultura orgánica, el Soconusco no tiene mucho que ofrecer, ya que el manejo ecológico se representa con únicamente el 0,5 % de la superficie total de la fruticultura, destacando los cultivos de mango (176 ha), rambután (60 ha) y banano (20 ha). En contrario a esto la área que ubica la cafeticultura orgánica que abarca una superpie de 1.142 ha, equivalente al 1,5 % de la superficie total de café en el Soconusco (75.373ha).

Las normas regionales del Soconusco integradas en la fruticultura orgánica se basan principalmente en la exclusión de pesticidas y fertilizantes de los huertos frutícolas, con fuertes deficiencias en el manejo bajo buenas prácticas agroecológicas, lo cual todavía deja las siguientes debilidades:

- En primer lugar se tiene: los viveros de especies frutícolas no mantienen un registro de procedencia del material vegetal para los nuevos individuos.

- Las plantaciones de frutales orgánicas carecen de un manejo de plagas y enfermedades, no se tiene un programa ni control adecuado y eficiente para las principales plagas (*Anastrepha* spp. y *Ceratitis capitata* (Wied.) y enfermedades.

- ▷ La fertilización se basa únicamente en la incorporación de los residuos de cosecha o de podas fitosanitarias.
- ▷ Las prácticas de conservación de suelo son muy escasas o más bien nulas.
- ▷ No se le da importancia a los abonos verdes ni al vermicomposteo y composteo.
- ▷ Asociación de cultivos solo se presentan en huertos de traspatio con asociaciones de plátano macho - mango.
- ▷ No se observan programas de recolecta de frutas infestadas después de la conclusión de la cosecha.
- ▷ No existe investigación sobre el potencial de las especies nativas para bioinsecticidas.

La agricultura orgánica en el Soconusco, podrá ser un sistema de producción que por las condiciones agro climáticas de la zona ofrece grandes oportunidades, para su explotación se tienen que sobreponerse a los siguientes obstáculos:

Cuadro 3: Oportunidades y obstáculos para la fruticultura del Soconusco, Chiapas; México.

Oportunidades	Obstáculos
1. Los productores tienen voluntad e interés para cultivar en manera orgánica.	– El grado de dominio teórico – práctico de la agricultura orgánica y de cultivos.
2. Las organizaciones frutícolas mantienen experiencias participativas.	– Las instituciones de apoyo se orientan a la implementación tecnológica de altos insumos.
3. La inspección y certificación de huertos (mango) frutícolas ya se ha desarrollado en el Soconusco.	– El productor desconoce del proceso de certificación y los beneficios del manejo orgánico.
4. El área exige una restauración de la fertilidad del suelo y la biodiversidad.	– Falta de estudios sobre manejos y especies para mejorar y conservar el suelo.
5. Se tiene la presencia de una ganadería extensiva y tradicional.	– Carencia de los conocimientos y costumbre de integrar fincas integrales.
6. Condiciones climáticas para abonos verdes y composteo.	– Agricultura con enfoque intensivo, con manejo de huertos libres de arvenses.
7. Diversidad de plantas aromáticas con potencial en el rubro de bio-insecticida.	– Debilidad en explotación material biológico regional.
8. Suficiente mano de obra familiar.	– Poca pasión y amor a la agricultura por los jóvenes.

Los productores de mango, rambután y banano orgánico, por su desconocimiento de las multipropiedades de este tipo de manejo están perdiendo interés sobre estos sistemas de producción. La carencia de cultura de conservación de los recursos naturales y respecto de los mismos, han provocado que los fruticultores en general no muestren el interés por la agricultura orgánica, además de esto se suma la debilidad de las dependencias de gobierno en la promoción del manejo orgánico de los huertos con frutas.

El manejo frutícola de estos productores esta basado principalmente en el no uso de fertilizante químicos ni pesticidas. Lastimosamente en su mayoría todavía no cuentan

con un manejo adecuado de coberturas del suelo y de abonos verdes. Tampoco se dedican a la producción de compostas y bioinsecticidas. Las practicas de la poda se realiza empíricamente y los predios carecen del riego.

Una situación similar presentan las áreas de producción de papaya en el Estado de Tabasco. El 80 por ciento de la superficie cultivada de papaya en Tabasco es con la variedad Zapote. Se cultivan otras en menor escala como: Criolla y Maradol. El alto contenido de humedad en el suelo ocasiona retrasos en el desarrollo durante las diferentes etapas fenológicas de las plantas de papaya, además de ocasionar daños como: pudrición de raíces, caída de flores y frutos e inclusive la pérdida total de las plantas, lo que implica la pérdida de la cosecha (Arrieta y Carrillo, 2002). El estado de Tabasco dispone de agua de lluvia durante la mitad del año, con una precipitación pluvial que varía desde 1800 hasta más de 4000 mm anuales, por lo que es común encontrar suelos con problemas de drenaje, en los que la producción de papaya se restringe. El papayo tiene la posibilidad de mantener su redituabilidad si se aplica la tecnología adecuada y tomando en consideración que esta fruta es uno de los cultivos que genera importante fuente de empleo y que además, es una actividad bastante redituable al proveer muy buenos ingresos, puesto que es un producto con alta demanda; siempre que se utilice la tecnología adecuada para la obtención de este producto con calidad y cumpla con los requisitos de acuerdo a la normatividad en materia de fitosanidad e inocuidad, indispensables para acceder a los mercados internacionales.

En el estado de Tabasco existen tres subregiones importantes productoras de papaya: Chontalpa, Centro-Sierra y Los Ríos, cada una con características diferentes entre sí, en la Chontalpa y Centro-Sierra se encuentra concentrado el mayor número de productores (175 productores) de superficies de 1 a 2 hectáreas, prevaleciendo una baja tecnología y buscando un manejo orgánico (cultivos de temporal y manual) de un total de 199 productores. En la región de los Ríos en donde existen menor número de productores y grandes extensiones con altas tecnologías (riego, mecanización y altos insumos químicos) con áreas entre 10 y 40 has.

A los productores de baja tecnología, ubicados en su mayoría en la subregión de la Chontalpa y Centro-Sierra y representando el 88 % en el estado, se enfrentan problemas como sequías o inundaciones, resistencia de plagas a los agroquímicos, compactación del suelo, reducción de materia orgánica y de insectos benéficos, además lluvia ácida debido a mechones de quemadores de gas cercana a los cultivos. Otros problemas mas son: Falta de recursos, infraestructura, equipo, análisis contables; debilidad de organización, capacitación y asesoría técnica, exposición continúa de los trabajadores a los agroquímicos, posibles enfermedades derivadas por el uso de agroquímicos; la venta a intermediarios, precios bajos, no la pueden vender toda, se madura y se echa a perder.

Esta triste realidad no deja ver actualmente el cultivo orgánico como una alternativa porque los costos de producción en la tecnología baja con 40.000,- Pesos Mex. por ha son todavía altas, el rendimiento para este sistema inicia a partir de los 6 meses de siembra y se cuenta con una producción de 1 a 4 toneladas efectivas durante 5 meses efectivos, considerando que debido a la baja inversión en control de plagas y enfermedades un 50 %

de la plantación resulta ser afectada, principalmente por virosis y ácaros (araña roja en secas y ácaro blanco en tiempo de lluvias debido al exceso de humedad y falta de drenaje adecuado según el tipo de suelo. La cosecha cada 10 días entrega 1-4 t/ha siendo un promedio de 2.2 toneladas y hasta 3 toneladas cuando tienen una mejor fertilización y atención de su huerta. En cada corte por planta cortan 2 frutos de papaya promedio, cuando ya empieza a rayar con un peso promedio de 1.7 kilogramos, de un total de 1100 plantas por hectáreas son 3.7 toneladas, considerando que el 50 % promedio resulta afectado por plagas y enfermedades.

7 La caña de azúcar orgánico en México. Oportunidades y obstáculos

En México, se cultivan 659.124 ha que representan el 3 % del área total mundial dedicada a este cultivo y ha alcanzado un rendimiento agrícola de aproximadamente 71.75 t/ha (Toledo Toledo *et al.*, 2005). En la zafra 2005-2006, fueron procesadas 47'290,412 toneladas en 58 ingenios para obtener azúcar, mieles, alcohol, entre otros productos. El azúcar forma parte de la canasta básica alimenticia de la población cuyo consumo per cápita es de 46 kg/año y además se necesitará azúcar orgánico para los procesamientos de las frutas orgánicas.

El entorno en el cual se desenvuelve la agricultura e industria azucarera mexicana ha venido cambiando aceleradamente en los últimos años. Actualmente, se plantea que si se quiere alcanzar un nivel de competitividad importante en el mercado mundial, principalmente con el Tratado de Libre Comercio con Canadá y Estados Unidos no es posible seguir produciendo azúcar como se venía haciendo hasta ahora (CNIAA, 2006). El aprovechamiento de los residuos de cosecha, los residuos de fábrica, los abonos verdes, los microorganismos como promotores de la descomposición orgánica, la necromasa microbial y los biofertilizantes, se proponen como camino hacia la sostenibilidad económica y autosuficiencia del cultivo de la caña de azúcar.

Las prácticas agronómicas para el cultivo de la caña de azúcar en México, se caracterizan por el uso intensivo de agroquímicos y por la incineración de follaje y residuos de cosecha, lo que provoca un apreciable deterioro del recurso natural suelo, además de daños colaterales para los agroecosistemas rurales y sus comunidades (Pohlan *et al.*, 2006; Martínez, 1993). Con la llegada del nuevo siglo, se han producido transformaciones a favor de la sociedad, dentro de las cuales la protección de los recursos naturales y la producción de alimentos libres de agro tóxicos han alcanzado una gran importancia. Hoy en el sistema caña de azúcar, se requiere iniciar una nueva modalidad en el conjunto de sus prácticas agrícolas, donde la utilización del fuego no sea una práctica más en la cosecha de la caña de azúcar y con esto se busca reintegrar a la naturaleza la mayoría de los recursos bióticos y abióticos eliminados o afectados por la práctica de caña quemada (Pohlan y Borgman, 2002). Muy importante es entender, que la caña de azúcar es uno de los cultivos más productivos e eficientes por sus grandes potenciales en la producción primaria, secundaria y en los aprovechamientos múltiples de sus residuos (Vu *et al.*, 2006; Cuellar Ayala *et al.*, 2003).

En este contexto, los productores de caña de azúcar en México, tienen la certeza de que aún existen muchos retos y oportunidades en la agroindustria de la caña de azúcar; elevar

los índices de eficiencia, innovar en los procesos productivos entre ellos la producción de caña orgánica y crear más y mejores oportunidades para los cañeros y empresarios, así como los trabajadores del campo y de las fábricas (Toledo Toledo *et al.*, 2006; UNICA, 2004).

Primer tarea para resolver esta en este contexto la quema de la caña, que se realiza desde la década del 70, la cual causa impactos ambientales negativos sobre las poblaciones asentadas alrededor de las áreas que tienen mayor influencia de este cultivo. Según la EPA el material particulado se emite durante la quema de la caña de azúcar es de aproximadamente 12 kg por tonelada de material quemado. La no quema de la caña de azúcar contribuye al mejoramiento de las condiciones químicas, físicas y biológicas del suelo. La hojarasca constituye en una de las fuentes de alimento y energía vegetales de los organismos heterotróficos responsables de la fragmentación de los residuos. Con el tiempo, se incorporan en proceso de mineralización. El aporte de biomasa al promover el reciclaje de nutrientes contribuye en la búsqueda de la producción sostenible del cultivo de la caña de azúcar. Como consecuencia de lo anterior, el manejo de la caña en verde tiene menores necesidades de fertilización nitrogenada contribuyendo a que se presente mayor acumulación de sacarosa en la caña (Pohlan *et al.*, 2005; Larrahondo y Villegas, 1995).

Después de la cosecha en verde quedan en el campo entre 50 y 70 t/ha de residuos verdes (cogollos, porciones de caña útil, hojas verdes y secas) con un contenido de humedad promedio de 60 a 65 %. Al cosechar la caña sin quemar se obtienen una serie de beneficios resultantes, como son una buena cobertura lo que reduce las perdidas de agua por evaporación, mejoran la penetración de la lluvia al suelo, reducen los riesgos de erosión, mejoran la fertilidad de los suelos, reducen la población de malezas y en general, se pueden seguir alternativas de labranza mínimas que resultan en menores costos de producción de las cañas socas.

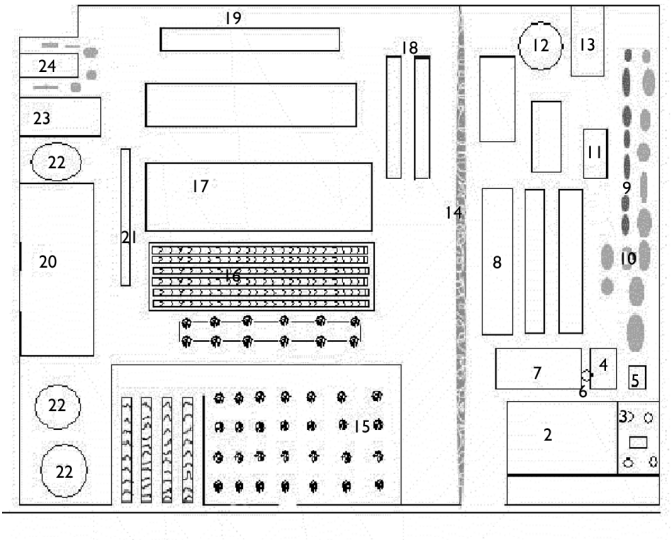
Las labores agronómicas dentro del proceso de transformación de la caña convencional a la caña orgánica están dirigidas a un manejo de arvenses en tal manera, que se lleva a cabo cuando en el área del cultivo se encuentren especies agresivas que estén provocando algún tipo de daño, utilizando utensilios de labranza como podadora mecánica o azadón, se aprovechará el material inerte de estos arvenses para cubrir el suelo, utilizar residuos de la cosecha de la caña para cubrir los entresurcos y otra alternativa es la de los cultivos intercalados principalmente con el frijol en la fase después de la siembra nueva y/o la resoca (Toledo Toledo *et al.*, 2006). La fertilización dependerá de los resultados del análisis del suelo antes de la siembra; en base a estos, aplicar humus de lombriz antes de depositar la caña (semilla) en el fondo del surco en el caso de las socas y resocas aplicar este producto orgánico antes del "aporque". Para el manejo de plagas y enfermedades se utilizan variedades resistentes a las diferentes enfermedades que atacan a este cultivo y se ha establecido un sistema de manejo integrado de plagas, lo cual incluye aplicar o liberar enemigos naturales como parásitos, predadores, hongos entomopatógenos, considerar el control etológico (trampas verdes), y algunas prácticas culturales. Cuando el rendimiento por unidad de superficie ya no es redituable, se recomienda "voltear" la caña, que por lo regular se lleva a cabo de 8 a 10 años después de su establecimiento en el campo.

Esta labor consiste en darle un pase de arado y de rastra para eliminar la cepa de la misma, posterior a éstas labores, se rastrea nuevamente el área para destinarla a la siembra de una leguminosa, de preferencia fríjol, que fija nitrógeno al suelo y rompe el ciclo biológico tanto de insectos-plagas como arvenses que pueden causar daños a la caña de azúcar. Además se ve como muy importante la reforestación en los áreas del cultivo. Se deben de establecer diferentes especies de árboles maderables (caoba: *Swietenia macrophylla*; cedro rojo: *Cedrela odorata*, roble: *Tabebuia rosea*; y primavera: *Tabebuia donnell smithii*) alrededor del predio y en las áreas libres de cultivo, con esto se aumenta la biodiversidad en esta área y con el paso del tiempo se aprovechará la madera de estas plantas para la construcción de casas, galeras y muebles.

8 La producción orgánica de frutas y vegetales en Cuba: "La Joya", un huerto ejemplo

En una apacible y bella comunidad de la zona norte del municipio San José de las Lajas, provincia La Habana, donde se observa el atractivo verdor del campo caribeño, se levanta un huerto ecológico integral "La Joya" de 3.400 m^2 fruto del esfuerzo creativo del productor Osvaldo Franchi-Alfaro Roque, quien a partir de un terreno destinado a la deposición de escombros de construcción, acondicionó para su uso agrícola (Figura 2).

Figura 2: Croquis del jardín Integral Escuela "la Joya" (cortesía del Prof. Justo, UNAH).



1-Cerca Perimetral.
2-Vivienda.
3-Gallinero.
4-Conejeras.
5-Jaula de codornices.
6-Tanque de peces.
7-Zeopónico.
8-Vivero de frutales.
9-Plátano.
10-Frutales y Café.
11-Colmenas.
12-Pozo.
13-Tanque.
14-Trepadoras, Frutale.
15-Guayaba y Apio.
16-Casa de cultivo 1.
17-Casa de cultivo 2.
18-Cantero de boniato.
19-Condimentos, flores, frutales.
20-Umbráculo
21-Lombricultura.
22-Area de compost.
23- Cant de Hotalizas.
24-Frutales y otros.

El inicio en el país en la década del noventa, del ingenioso movimiento productivo agropecuario, de la llamada Agricultura Urbana, estimuló a muchos empleados estatales de origen campesino, a recesar en sus funciones e incorporarse al movimiento productivo urbano, como vía para la solución de las necesidades de la familia y la comunidad. Así se inicia como productor, el funcionario estatal de origen campesino, Osvaldo Franchi-

Alfaro Roque, cuya familia, constituida por cuatro mayores y una menor, vive y trabaja en el huerto, con la ayuda de un productor amigo retirado. Los principios que sostienen su filosofía son: escuchar, aplicar y comprobar con su propia creatividad, las propuestas de amigos productores, investigadores y científicos. Su propósito es lograr rentabilidad económica, con protección medioambiental. Su nivel de creatividad lo llevó a la creación de un programador de riego ecológico, primicia mundial, cuya reproducción a escala internacional ha autorizado, sin cobro alguno. Su experiencia es única y constituye un ejemplo para el territorio la provincia y el país.

La diversidad de los cultivos es una característica clave en el manejo de cualquier huerto. Sus principales productos comerciales son: las posturas o plántulas de hortalizas de hojas y frutos y la venta de posturas; de guayaba, Aguacate y mango, plántulas que logra en corto tiempo por el novedoso método de la producción por esquejes. También produce "Yerba buena" para hacer "Mojitos" (bebida preferida de Hemingway). Esta producción la logra intercalada entre la plantación de guayaba que utiliza como banco de semilla asexual para preparar los esquejes. Dentro de los cultivos alimenticios predominan las verduras de hojas como lechuga, col y acelga, aunque produce también, pepino, tomate, rábano, perejil y culantro entre otros. Dentro de las raíces, tubérculos y cormos, produce boniato, papa, yuca, ñame y plátano. También cuenta con algunos árboles frutales como mango, aguacate, anonáceas como guanábana, anón y chirimoya y guayaba; de esta última, cuenta con 200 plantas madres, para la obtención de esquejes y la producción adicional de guayaba que es vendida a la población como fruta fresca. La huerta cuenta con 189 variedades de plantas y el componente animal de crianza, tiene en total 11 especies, y el manejo que realiza, favorece la estabilidad del sistema y al control ecológico de plagas, las que maneja de manera natural.

El componente relacionado con las alternativas nutricionales para las plantas lo conforman entre otros la lombricultura, especie *Eisenia foetida*. Esta lombriz descompone el compost y estiércoles para convertirlos en un fertilizante de alta calidad que aporta nutrientes y carga bacteriana al suelo, mejorando sus características físicas, químicas, y biológicas. El compost se obtiene de los restos de cosechas que sirve de alimentos para las lombrices, quienes terminan degradando la materia orgánica para convertirla en humus. Dentro de los llamados biofertilizantes y bioestimulantes, emplea Micorrizas a través de un nuevo producto (*Ecomic*) obtenido por el Instituto Nacional de Ciencias Agrícolas (INCA), utiliza además el *Fitomas*, producto obtenido de la caña de azúcar, estimulador del crecimiento vegetal y que fuera logrado por el Instituto Cubano de Investigaciones de los Derivados de la Caña de Azúcar (ICIDCA) y *Biostán* y *Liplant* ambos productos derivados del humus de lombriz, logrado en la Universidad Agraria de La Habana (UNAH). Estos componentes son utilizados por el productor inteligentemente de tal forma que constituyen un sistema de manejo para el crecimiento y desarrollo de las plantas de forma integral. Sin embargo, debido al tamaño del predio y a la agricultura intensiva que se realiza, esta no restablece la materia orgánica que requiere el suelo para desarrollar los cultivos respectivos y sucesores, por lo que tiene que importar al predio materia orgánica que adquiere mediante contrato con el estado y así mantiene niveles promedio de 5 % de MO en el suelo. El componente apícola, lo sostiene con dos especies

de abejas, ubicadas en dos puntos del jardín, para ayudan a la polinización de las plantas y obtener miel para el consumo familiar. El componente piscícola, compuesto por pez Claria o pez gato, se encuentra en un recipiente cilíndrico, donde circula el agua y se alimenta de desperdicios de la preparación de los alimentos para el consumo y residuos de cosecha.

Para el manejo de plaga, utiliza un Purín – biofertilizante compuesto de follaje de plantas repelentes por sus olores que conserva en condiciones anaeróbica con agua enriquecida biológicamente, a partir de humus o vermicomposta. También utiliza la cal y la siembra de plantas repelentes, por tanto, el manejo de los cultivos se realiza bajo un enfoque agroecológico, al no emplearse fertilizantes y plaguicidas químicos sintéticos, fomentando así el equilibrio del sistema a través de la diversidad de la finca, rotación y asociación de cultivos, logrando, niveles de utilización del suelo de 3 a 4 ciclos por superficie al año. Se puede verificar el manejo de coberturas en toda el área así como el manejo de policultivos combinando colores y olores para conformar una mezcla oportuna, capaz de regular la presencia de fitófagos. Este productor maneja los Mecanismos de Regulación Biológica y desde el inicio, ha estado exento de daños severos por plagas, que lo afecten económicamente, las que en general, no llegan a rebasar los umbrales de perjuicios, evidenciando el papel que cada especie juega en el agroecosistema, en la conformación de nichos ecológicos equilibrados. La ubicación de plantas trampas y repelentes, dispuestas convenientemente en barreras o dispersas en el patio, y la utilización de productos botánicos en forma de soluciones o fluidos que son asperjados convenientemente, permite constatar las habilidades del productor para lograr el régimen de equilibrio, ejemplo de la agricultura agroecológica.

El productor no lleva registros sobre producción, rendimientos y economía. El calcula algunos rendimientos a partir de las observaciones directas en el momento de cosecha, y teniendo en cuenta el espaciamiento entre las plantas, la superficie y la masa de cada producto entre otros elementos fitotécnicos. El productor mantiene un nivel de conocimiento sostenido de sus ingresos que asciende a 5 veces de lo que en promedio recibe cualquier productor por año, lo que demuestra la viabilidad del sistema. De estos ingresos contribuye con un 10 % al sistema tributario. En los últimos dos años los ingresos han mantenido cierta estabilidad, dando muestras de estarse acercando a su máximo potencial, no obstante hay que esperar por los habituales cambios en el proceso de comercialización, que alteran el proceso e irregularidades en los ingresos del productor. El total de gasto cuantificable /año es de un tercio del total Neto mostrando viabilidad económica porque los ingresos superan siempre los dos tercios de los gastos, que destina equilibradamente a gastos familiares e inversiones para el agroecosistema. Los costos de producción están relacionados con las compras de la materia orgánica, el pago de la mano de obra, el uso de biofertilizantes y la adquisición de semillas certificadas no producibles en la parcela. Los ingresos dependen en gran medida de las ventas de hortalizas, frutas, posturas de frutales y hortalizas, plantas aromáticas y condimentos y colabora socialmente con la comunidad enviando productos a muy bajo precios o gratuitos a un circulo infantil, un hogar materno y una escuela de niños discapacitados; también ayuda de igual forma a otros vecinos con problemas de muy bajo ingreso financieros. Actual-

mente tiene 4 tipos de ventas: posturas (población, estado), hierba buena (población, turismo) guayaba, viandas y hortalizas.

Para mantener el equilibrio financiero siempre piensa en el futuro. Prefiere vender en la casa para estar siempre con la familia y establecer las redes sociales con sus compradores. El destino de las ventas: 70 %, directa a la población, 10 %, al turismo 10 %, deberes sociales, 10 %, consumo familiar. Hace un presupuesto diario (costo de desayuno, almuerzo, comida) y mantiene una reserva de animales para autosostenimiento.

Sus valores socioeconómicos se resumen en lo siguiente: $i)$ la producción en familia es más viable y espiritual; $ii)$ siempre trabaja para ser el primero y lucha por un acercamiento a la sostenibilidad; $iii)$ los productos ecológicos los vende a igual o menor precio que el que establece el mercado agropecuario; $iv)$ se siente estimulado moralmente porque ayuda a mejorar la dieta de la población; $v)$ para él, su huerto y su programador de riego son "patrimonio de la humanidad; $vi)$ prefiere la ayuda simbólica, la cual considera más importante que dinero."

9 Resultados de la entrevista Feria Orgánica en Tapachula, Chiapas

El incremento de los mercados orgánicos, en muchos países de América Latina, es un indicador de que los consumidores prefieren adquirir productos libres de agroquímicos y a la vez contribuir en la conservación de la agro biodiversidad y el ambiente. En diferentes ciudades de México se han desarrollado una red de tianguis orgánicos que, ofrecen a los consumidores productos sanos. Uno de los problemas que se presentan, en Tapachula, Estado de Chiapas, es la presencia de enfermedades que están relacionadas con el uso de agroquímicos en la agricultura, los cuales son altamente nocivos para la salud. Aún así en esta región no se ha establecido una feria ni mercados que ofrezcan productos orgánicos, aun cuando existe un gran interés de los consumidores por adquirir estos productos saludables.

Por esta razón en Tapachula se realizó una encuesta de septiembre a diciembre del 2006, con el fin de determinar la viabilidad de establecer la Feria Orgánica en esta ciudad. Los resultados obtenidos son muy interesantes, algunos de ellos indican que un 81,8 por ciento de los entrevistados no consumen productos sanos, libre de químicos y mas nutritivos. Además el 100 por ciento de los encuestados (n= 217: amas de casa, obreros, campesinos, profesionales, estudiantes y pequeños empresarios) mostraron mucho entusiasmo en participar en esta Bichama (Feria MAM) orgánica. Estos consumidores de Tapachula solicitan alrededor de 45 productos entre: Hortalizas, frutas, carnes, café, huevos, miel de abeja, bebidas, tortillas, leche y chocolate, pero la feria orgánica no solo debe promover esos productos sino productos no comestibles, como: Aceites esenciales, semillas, abono orgánico, libros, ropa, artesanía, música entre otros. Los cuales deben estar en armonía con la conservación de los recursos naturales. También es necesario destacar que, un 59,0 por ciento de los consumidores sabe que es agricultura orgánica, lo cual da la oportunidad no solo de reforzar sus conocimientos sino implementar el saber al resto de la población sobre el consumo de productos orgánicos. Igualmente numerosos agricultores orgánicos, de esta región, mostraron interés en participar en la feria orgánica de Tapachula. Esto se debe a que en la actualidad una gran mayoría, de

estos campesinos, no tienen un mercado para comercializar sus productos producidos orgánicamente. Lo antes mencionado nos indica que en Tapachula existen proveedores orgánicos y una clientela dispuesta a adquirir productos sanos para mejorar la salud de la población.

A partir de estos resultados de la encuesta, CASFA y ECOSUR están planificando e impulsando una feria orgánica que ofrezca al consumidor la posibilidad de adquirir un producto orgánico certificado. Para conseguir este propósito, es importante establecer una estrategia que involucre las participaciones conjuntas, desde la planificación, a las instituciones del estado y del sector privado, universidades organizaciones de productores, civiles, profesionales, técnicos y consumidores. La participación de estos sectores de la sociedad es fundamental para la creación de los comités, los cuales serían los responsables del éxito de esta feria. El establecimiento de La Feria Orgánica en Tapachula sea importante y necesaria para (i) mejorar la salud de los consumidores, (ii) fortalecer las organizaciones de productores, la capacitación (Consumidor-productor en aspectos agroecológicos y de salud), (iii) crear una conciencia ecológica, económica y social para producir y consumir en forma responsable, (iv) promover la filosofía de la agricultura orgánica y (v) ofrecer espacios para la convivencia y el desarrollo de la sociedad.

10 Desafío

El establecimiento y la explotación de diferentes zonas con sistemas orgánicos debe ser un reto. En esto, el cultivo de hortalizas y frutales, especies tradicionales para la exportación, plantas aromáticas, y muchos mas pueden ser parte de cualquier sistema agropecuario. Importante en este contexto son costumbres alimenticios, tradiciones culturales y socio - étnicos, razones económicas y la cadena productiva desde el productor hasta el consumidor, y claro que sí las condiciones edafo – climáticas. La zonificación depende de los criterios antes mencionados y esta presente en muchas regiones tropicales. En nuestros estudios hemos encontrado una diversidad grande caracterizada por la naturaleza, por la intensidad cultural de los productores y las propuestas del mercado regional y de exportación. Por esto no es fácil agrupar sistemas y niveles de la producción en cualquier manera. Sin embargo siempre hemos notado posibilidades múltiples para desarrollar la fruticultura orgánica y presentando así una columna vertebral en manera ecológica, económica y social.

Los pequeños productores latinoamericanos han mantenido en sus fincas, huertas y conucos una alta biodiversidad. Allí existen muchas plantas con efectos de multipropósito, viven muchos sueños de hacerse rico con sus productos, pero faltan conocimientos básicos para un cultivo y procesamiento adecuado y hay un desconocimiento total sobre el mercado y sus enlaces. Por esto andamos mucho más cerca ponernos en el sarcófago que progresar en el dibujo del jardín Edén.

Es satisfactorio poder constatar que ya existen ejemplos viables de la fruticultura orgánica para diferentes regiones y países en Mesoamérica. Sin embargo, mucho más importante para el excito o fracaso de cada sistema es el cumplimento de la exigencia **¡calidad es todo!**

Para llegar a este punto tan definitivo se debe respetar las siguientes pautas:

- ▷ producir que tiene posibilidad de ser vendido o usado en el mercado regional, nacional y de exportación;
- ▷ obedecer los requerimientos de las especies seleccionadas en cuanto al suelo, clima, altura sobre el nivel del mar y infraestructura;
- ▷ cumplir todos los aspectos de la buena práctica en cultivos orgánicos;
- ▷ generar valor agregado en las actividades de procesamiento y almacenamiento.

Indudablemente el futuro debe y va a entregar a nuestras fincas un nuevo tipo de agricultores, fruticultores, ganaderos, los cuales son jóvenes, han aprendido de sus padres y abuelos, fueron educados profesionalmente y por esto van a ser capaces de manejar la agricultura orgánica en el trópico en una manera sostenible y en un estilo viable y moderno. Así el trópico jugará un papel mucho más importante que en los siglos anteriores en garantizar:

- Más diversidad y calidad en la producción frutícola;
- Más trabajo diversificado en las zonas rurales;
- Más estabilidad en los rendimientos;
- Menor deterioro en las condiciones ambientales;
- Mayor avance en la conservación y reforestación;
- Mayor éxito en la comercialización.

Organic horticulture in the tropics: Situation and examples from Meso - America

Abstract
The situation of organic horticulture in Meso - America is difficult to qualify and to quantify. Although certified organic horticulture is practiced throughout the subcontinent, statistical documentation is not up-to-date. On the other hand, many smallholders cultivate fruits and vegetables without fertilizers nor pesticides as they are short of financial means. This study is based on examples and recommended practices. Various farmers' attitudes are presented and their advantages and disadvantages critically discussed. More emphasis was spent to chayote cropping in Costa-Rica and Mexico, to pitahaya in Nicaragua, to papaya in Tabasco, to mango, rambután and sugar cane in Chiapas, Mexico, and finally to the family gardens in Cuba. Results of public consumer survey indicate, (i) the consumers' clear interest to buy organic products, (ii) the opportunities for establishing interactions between farmers and consumers as part of overall agro-ecological development and, (iii) the need to improve education of consumers and farmers in the agro-ecological aspects of human health.

Keywords: organic horticulture, Meso-America, chayote, pitahaya, papaya, mango, rambutan, sugar cane, family gardens, Costa-Rica, Mexico, Nicaragua, Cuba

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Emergence of Participatory Rural Appraisal (PRA) Technique as a Strategy towards Sustainable Development: A Sri Lankan Experience

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Abstract

In this millennium all the development activities are mostly focused on sustainable development, *i.e.* the development which fulfils the requirements of the present without disturbing the utilization of future generation. Basically, the sustainable development deals with environmental, social, and economical initiations. In relation to these three objectives, community participation plays a key role as an effective strategy for sustainable development. Among the numerous types of participation, Participatory Rural Appraisal (PRA) technique is the most relevant effective method to receive the participation. Because, it has been strengthen by bottom up approach, well defined objectives, practicable solutions, and remedies. Hence, the out come of such an event is most productive rather than a top bottom approach techniques. In fact, a PRA was practiced to develop a strategic plan for *tsunami* affected village – *Bambaranda* east, in southern province of Sri Lanka. PRA sessions were carried out during February, 2007 by the Department of Agric. Economics of *Ruhuna* University, Sri Lanka in collaboration with Japanese Green Resource Agency, Japan.

Participatory mapping, venn diagram, matrix ranking, preference ranking, and pair - wise ranking were demonstrated to gather information from the community. The *tsunami* affected area, including the paddy fields, four irrigation canals were shown by the group with the help of the participatory map. Preference ranking was resulted the reconstruction of irrigation canals as the most important rehabilitation activity to recover the livelihood of villagers. Intrusion of sea water into the paddy fields was the main limitation revealed by the pair - wise ranking. The second limitation marked as unavailability of enough fertilizer and the dilapidated irrigation canals was the third that has to be solved. Matrix ranking was employed to identify the most facilitated sectors by the government and other institutes in order to detect the areas which need to pay further attention. By that, the community realized that the rehabilitation of irrigation canal is the least benefited area where any development activity should be addressed in order to up grade their livelihood. Finally, a venn diagram was executed to identify the service providing entities in the community. It explored the Agrarian Service Center (ASC) as

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the most important service providing institute which keeps a close relationship with the community. The second and third places were acquired by *Sanasa* and *Samurdhi* office. Therefore, the most appropriate institute to launch any sort of development activity is ASC, *Sanasa*, or *Samurdhi* office.

With the light of these exercises, now the funding agency is activating in *Bambaranda* village by constructing the irrigation canals and also the estuary. Moreover, the implementation was carried out under the supervision of ASC with efficient participation of villagers. In fact, the PRA has given the correct path that would direct towards sustainable development with community participation.

Keywords: PRA, community participation, tsunami, Sri Lanka

1 Introduction

With every passing year, Sri Lanka has had major challenges set on it. Being a developing country, the foremost element is to reach the development level that should strive on to achieve in all aspects that concerns. People are more conscious on short term benefits in order to meet their day to-day needs as a society. But in an era of number of natural hazards, climatic changes, and technological changes, it is important to drive towards a long term goal setting. These would not be achieved over night, a year or ten years may be taken, but will result an ever lasting development process, which can be referred as sustainable development.

Sri Lanka is mainly based on Agriculture as the contribution to the GDP accounts for 17 percent (Central Bank of Sri Lanka, 2005). A considerable portion (32.2 %) of the population also depends on agriculture to meet their basic needs of food, water, fuel, housing materials. . . *etc.* In addition, the environment and the natural resources are being exploited for commercial purposes as well. For an example; coral mining, timber harvesting, sand mining, honey collection, farming, aquaculture can be highlighted. Being a country, having a prolonged civil disturbances, suffered by a destructive natural hazard like *tsunami* (on 26th of December, 2004), and poverty (more than 45 percent of population are under the poverty line), are detrimental to our environment and may lead to exploit the nature at a higher rate. These reflect the need of a well planned strategic approach to a developing country like Sri Lanka.

The strategies should include the economic growth that would favour the poor (who earns less than US $2 per day is 41.6%) and poverty alleviation schemes should be promoted. The fiscal policies which may negatively affect the poor (due to heavy taxes levied on goods, eg; Value Added Tax) and other policies those promote environmental degradation (sand mining, coral mining, timber harvesting) will need to be reformed. The stock of human capital, social capital and total investments should increase, since those are the reflectors of economic growth and would enhance innovations which are paramount in sustainable development. Disparity of income between rich and poor (measured by Gini Coefficient, 0.46 in Sri Lanka) must be controlled. One important dimension under sustainable development is political stability, peace and security, which is seriously damaged in Sri Lanka, because of the civil war between terrorists and the

public. Hence, the political instability, violent conflicts, and the civil war hinder the socio – economic progress of the country at a threatful rate. In fact, leading to sustainable development is required a very strategic approach to develop a country like Sri Lanka, because we have a number of constraints and difficulties to enter in to the path. Some of the difficulties are; Capital deficiency, lack of new technology, lack of awareness, improper planning, implementation, and monitoring. Therefore, the strategic process of a developing country is basically : under the external impetus (IUCN, World Bank, UNDP, ADB), donor – funded, bureaucratic projects aimed to increase the production, consumption, rural development or an environmental issue, created by a NGO. Those strategies must need certain criteria to furnish the task in a sustainable manner as shown in the fig. 1.

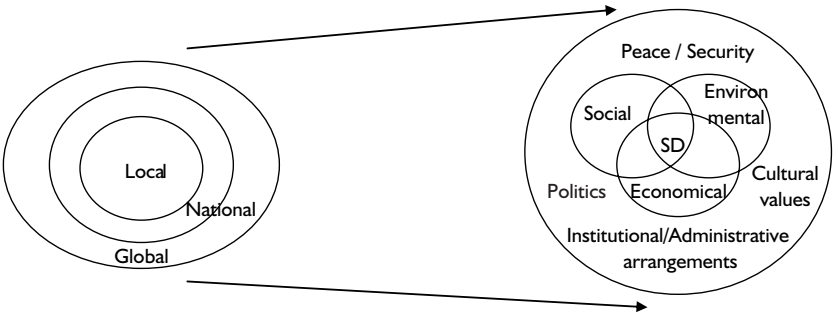
Figure 1: Important components in sustainable development

2 Sustainable Development

The definition on sustainable development is given by the Earth Summit, 1992 as ; "Nation are able to achieve positive economic and social development, without excess environmental degradation in a way that both protect the rights and opportunities of coming generations and contributes to compatible approaches else where" (Earth Council, 2000). The same has defined by the Brundtland commission (1987) in a simply manner as the development that meets the needs of the present without compromising the ability of future generation to meet their needs (UNEP, 1999). Hence, sustainable development means more than environmentally sound, but unites environmental, social and

economical concerns and initiations. According to this, the three pillars which uphold the sustainable development is; social objectives, economic objectives and environmental objectives. Further, the concept of sustainable development can be illustrated as a holistic development approach over six dimensions: economic, social, environmental, politics, technology and knowledge, and natural and spiritual balance (fig. 2). Thus,

Figure 2: The main elements of sustainable development Source: DALAL-CLAYTON *et al.* (2000), Modified by BARBIER (1987)



sustainable development is not a single parameter of environmental issue, but a complex concept. Achieving Sustainable development will require deep structural changes and new ways of working in all areas of economic, social, and political life.

3 Community Participation as a Key Strategy for Sustainable Development

Community participation is one of the major conceptual strategies in sustainable development, because it creates several paradoxes as; to justify the extent of control of the government, to build local capacity and self reliance, to justify external decisions, to devolution of power and decision making away from external agencies, for data acquisition by experts, and for interactive analysis. Hence, the term *participation* has been defined as; "a process through which stakeholders influence and share control over the development initiatives, and the decision and resources which affect them". Thus, everyone agrees that participation is both a right and a practical necessity where the Agenda 21 called for the "maximum possible participation for sustainable development" (WORLD BANK, 1992).

There are many types of participation in local level development *viz*, manipulation participation, passive participation, participation by consultation, participation for material incentives, functional participation, interactive participation, and self mobilization (OECD, 2002). Among those types of participation the interactive participation seems to be best because there the local community participates for joint analysis, decision making, action planning, and implementation. Here, the formation or strengthening of local groups or communities are done by external party. The learning methods are used to seek multiple viewpoints. Study on effective participation should have some basic

requirements to fulfil in order to achieve the goals or the objectives of the event as follows:

- The group or the community should have clear well-defined objectives to be participated and a *proper understanding* on what is happening and *what are they going to do*.
- *Catalyst* is very much important for an active participation with motivation and commitments. Mostly this catalyst part will be done by an extension institution, Non Government Organization (NGO), or local authority.
- The group or the community must have *specific activities and events* round which to focus.
- There should be a *modest starting point*. The gathering should start modestly, build honestly, and deepen towards the objectives; means there must be a phased approach towards the goal.
- The group can use many *tools* for appraising needs, opportunities and possibilities, ranking solutions, resolving conflicts, for reaching solutions which they face in day to day activities.
- These types of participation techniques may need *resources, materials, skills and time and a good learning environment* without any forces or threats.
- Finally the outcome should be *demonstratable*, could be explained and beneficial for the community which needed to be convenience that their investment of time and other resources will have a positive input.

4 Participatory Rural Appraisal (PRA)

Effective participation needs number of requirements and results powerful information, and strategic plans for the development process. PRA is a crucial method of an effective participating which fulfils all the requirements discussed above. It is a technique applied with community participation with the collaboration of the resource agency and the institutes. The fig. 3 shows the contribution of each sector for an efficient PRA exercise. Figure 3 illustrates that the PRA is an interaction of facilitating institutes, resource / research institutes, and the community. The resource / research institute should have skilled staff to conduct the PRA programme in an efficient manner, and the institute could be able to mobilize resource personnel according to the requirement. On the other hand, the facilitating institute could be able to render the financial facilities, managerial and technical facilities, equipment and also should be able to contact relevant bodies to arrange this type of event. The participants or the community must be well nourished with skills, experience and on going know how on the field they are involving. When all these requirements are presence, an efficient, effective and a fruitful PRA exercise can be demonstrated.

Hence, PRA is an invaluable strategy to enhance the participation component under sustainable development. Therefore, this was practiced to develop a strategic development plan for *tsunami* affected village – *Bambaranda* east - in Southern province of Sri Lanka. The resource institute was Department of Agric. Economics, Faculty of Agri-

Figure 3: The key components and their strengths in PRA

culture, University of *Ruhuna*, Sri Lanka and the facilitating agency was the Japanese Green Resource Agency, Japan. PRA sessions were carried out during February, 2007 to gather information in many aspects related to *tsunami* rehabilitation activities.

5 Application of PRA for the Sustainable Development in a Tsunami Affected Area: A Case Study in Bambaranda East – Matara District, Sri Lanka

Tsunami, the giant harbor waves hit on the Sri Lankan coast on 26th of December, 2004, and the entire coastal region affected badly. As a result, the breath of thousands of people mixed to the brine and thousands of people lost their livelihood activities, houses in both fisheries and agricultural sectors. Hence, a rapid, but effective development process was required to rehabilitate the area and to bring up the *tsunami* victims to the normal. But, Sri Lanka is a developing country with huge capital deficiency (more than 20 percent of GDP spend on the civil disturbances). Therefore, to fulfill all the necessities as requested by the refugees were a huge problem that had to be addressed. *Ipso facto*, the identification of most essentials, limitations, and the institutions to be involved in the process were paramount. In fact, PRA techniques were applied to sense the so called important facts of the community. The following paragraphs demonstrate the case study conducted in the village Bambaranda-East in Southern province of Sri Lanka.

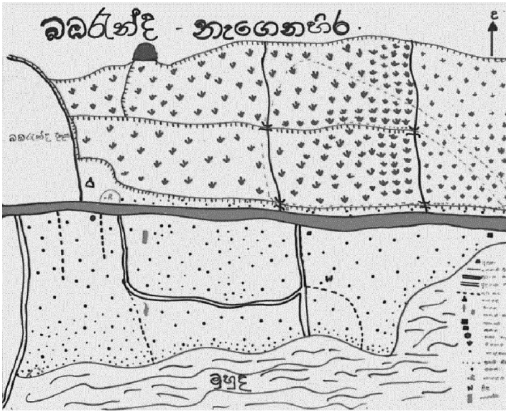
This village is based on agriculture with 44.13 ha (109 acres) of paddy fields. Villagers had lost their houses, farming equipment and also lost the fertility of their farming

lands which were covered with sand and debris. Participatory mapping, venn diagram, matrix ranking, pair - wise ranking and preference ranking were used as PRA tools. The participants were grouped in order to practice each tool by assigning 10 – 15 people into each group.

6 Participatory Mapping

A map of the village – *Bambaranda* –East was drawn with the participation of all the group members. The village has 46.56 ha (115 acres) of up lands, 44.13 ha of paddy fields. There are 261 families, of that 114 are mainly depending on paddy cultivation. Apart from that, coconut and banana also cultivate as other field crops. The village is being irrigated by four irrigation canals. There are five government institutes as the school, Agrarian Service Center, *samurdhi* office, post office and the co-operative. The garment factory, timber mill, and coir industry are the other employment generating sources of the area. Due to *tsunami*, all the irrigation canals and more than 24 ha (60 acres) of paddy fields were damaged and became unproductive due to the high salinity. The participatory map is shown in fig. 4.

Figure 4: Participatory map of *Bambaranda East*



7 Preference Ranking

This technique was applied to get the individual's preference over certain criteria. The criteria also put forwarded by the group. Then those were ranked according to their preference, and finally all the ranks were totaled and got the average. The averages were ranked according to the ascending order. In this respect, the group tried to select the most important activity that has to be implemented to recover their livelihoods. In connection, reconstruction of irrigation canals, rehabilitate the paddy fields, develop coir industry, home gardening, and cultivate abandoned paddy fields were the criteria (table 1). Of that, the highest preference went for the reconstruction of irrigation canals. Paddy field rehabilitation, and cultivate abandoned paddy field were ranked as the sec-

ond and third important activities. But least priority was given for the home gardening and coir industry.

Table 1: Major requirements of the Bambaranda East community – after tsunami

Member	*Irrigation*	*Coir Industry*	*Rehabilitate paddy fields*	*Home gardening*	*Paddy cultivation*
1	4	5	2	3	1
2	1	2	5	3	4
3	1	4	3	2	5
4	2	5	1	3	4
5	1	5	4	3	2
6	1	2	5	3	4
7	1	5	2	4	3
8	1	2	3	5	4
9	3	5	2	4	1
10	1	5	4	3	2
Total	16	40	31	33	30
Average	1.6	4	3.1	3.3	3
Rank	1	5	3	4	2

8 Pair - wise Ranking

This tool is important to find out the most limiting factors in the community. A number of limitations were listed down under a pre determined topic and arranged in a matrix as horizontally and vertically. Then each limitation was compared one against another and marked the number of most severe problem. Finally, count the times that each problem appeared and ranked according to the descending order. The farmers in *Bambaranda*, listed out their limitations encountered in paddy cultivation as; intrusion of sea water to the *Pallewelayaya* (name of the paddy field), dilapidated irrigation canals, difficulties to obtain seed paddy, lack of machineries and equipment, lack of high yielding varieties, unavailability of fertilizer at the correct time, poor extension services, and low price for the harvest (table 2). The final out come reveals the intrusion of brine water into the paddy field as the main limitation of the area where it appeared eight times. The second limitation was the unavailability of fertilizer and the dilapidated irrigation canal was the third. But the price of paddy and poor extension service were not serious problems. Therefore, the development process should try to solve the major limitation of sea water intrusion prior to any other activity.

Table 2: Limitations encountered in paddy cultivation

Problem	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*Marks*	*Rank*
1. Intrusion of sea water to the *pallewelyaya*	X	1	1	1	1	1	1	1	1	8	1
2. Dilapidated irrigation canal		X	2	2	2	2	7	2	2	6	3
3. Unavailability of water for the cultivation			X	3	5	3	7	3	3	4	5
4. Difficulties to obtain seed paddy				X	5	4	7	4	4	3	6
5. Lack of machineries and equipments					X	5	7	5	5	5	4
6. Lack of high yielding varieties						X	7	6	6	2	7
7. Unavailability of fertilizer at the correct time							X	7	7	7	2
8. Poor extension services								X	8	1	8
9. Low price for the harvest									X	10	9

9 Matrix Ranking

Matrix ranking is vital to select the best alternative over certain criteria among number of solutions. First, the community proposed an objective where they want to evaluate the possible alternatives as solutions. Here, the farmers decided to evaluate the sectors that have been facilitated by external parties in the area. The alternatives were distribution of agricultural inputs, rehabilitation of irrigation canals, availability of agricultural equipment and machineries, extension service, and seed paddy distribution. Then those were evaluated using the criteria of, money allocation, labour, time, institutions involvement and government support. A predetermined 25 marks were allocated to each criterion and distributed among the alternatives after arranging as a matrix (table 3).

Table 3: The least facilitated sections in paddy cultivation – after *tsunami*

Criteria / Alternatives	*Money allocation*	*Labour*	*Time*	*Institution involvement*	*Government support*	*Total*	*Rank*
Distribution of agricultural input	3	6	10	10	8	37	1
Rehabilitation of irrigation canal	1	1	1	1	1	5	5
Availability of agricultural equipment	4	2	8	3	9	26	3
Extension service	13	8	3	9	3	36	2
Seed paddy distribution	4	8	3	3	4	26	4
Total	25	25	25	25	25		

Finally, the total was ranked in descending order in order to find the mostly facilitated development activity. As the end result, the distribution of agricultural inputs, extension service and availability of agricultural equipment and machineries were ranked as first, second, and third. Therefore, those are the most facilitated activities progressing in the

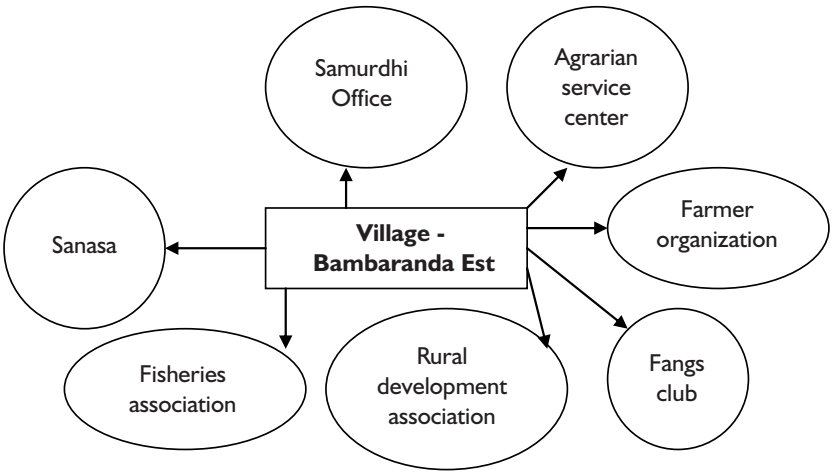
area. Rehabilitation of irrigation canals is the least benefited activity that has to be addressed in order to accelerate the development process where it obtained only five marks. Therefore, any development activity should focus on this rather than facilitate any other activities.

10 Venn Diagram

In a village, there are many service providing institutes, organizations, and individuals. Venn diagram is a tool to reveal the relationship between those service providing entities and their significance. First of all, the community must understand the service providing institutes, organizations, and individuals in the area. Then the venn diagram prepares based on two rules as the relationship is inversely related to the distance and the significance is proportionally related to the size of the denoted circle. Accordingly, the circle (which represents the service providing entities) arranged as a venn diagram (fig. 5).

Agrarian service center, farmer organization, *samurdhi* office, *Sanasa*, Rural development association, fisheries association, and fangs club are the service providing entities in *Bambaranda* village. Of those, the ASC provides a vital service to the farming community, but the relationship is somewhat low. On the other hand, *sanasa* has a very close relationship with villages as well as provides a significant service. The *samurdhi* office also keeps a close relationship while rendering a remarkable service. But the fisheries association and the rural development association contribute its service at a lower level where the relationship also very weak. Hence, this exercise elicits that the most suitable organizations to carry out any development activity are *Sanasa*, *samurdhi* office, and the ASC.

Figure 5: Venn diagram for *Bambaranda east*



11 Forward Activity Based on PRA Experience

After conducting the PRA exercise, the responsible institute – Japanese Green Resource Agency launched its rehabilitation activities in *Dickwella* Divisional Secretariat in *Matara*, Southern province of Sri Lanka. As the first step, it started to reconstruct the dilapidated irrigational canals in the area. The development process is implemented under the supervision of ASC which was the most significance and closely interactive service providing institute in the area. The activities are progressing with the participation of villagers, Agricultural Research Production Assistants (ARPAs), and the J – Green Agency. The entire process seems to be successful where all the three parties have one goal and blessed with the community consent. This is the essence towards sustainable development for an enlightened future.

12 Conclusion

According to the executed PRA session for the *Bambaranda* east farmers, could obtain many important information. The participatory map indicated that the villagers main livelihood is paddy cultivation and that was damaged and becoming unproductive due to the tsunami devastation. The preference ranking was done to select the most important activity to recover the livelihoods of villagers. Highest preference went for reconstruction of irrigation canals. Paddy field rehabilitation and cultivation of abandoned fields were second and third preferred activities by the community. Pair - wise ranking was demonstrated to identify the most limiting factors or pressing problems in the community. The results annotated that the intrusion of brine water into the paddy field as the main limitation. Unavailability of fertilizer and dilapidated irrigation canals were the second and third respectively. In fact, any development process should find out solutions to these burning issues prior to launch any other activity. Farmers tried to identify the least attention paid sectors using matrix ranking. They came up with; the distribution of agricultural inputs, extension services, and availability of agricultural equipment and machineries as mostly funded and facilitated sections by the institutions. But, the rehabilitation of irrigation canal has been abandoned. Therefore, the community needs more attention towards it which is combined with their livelihood, paddy cultivation. An evaluation was carried out on service providing entities in the area using a PRA tool called venn diagram. It depicts that the most significant and interactive institute for the area is ASC. *Sanasa* and *Samurdhi* office were positioned as the second and third places. As such, the PRA exercise gave a good starting point for the development activities. Therefore, PRA is an essential component to lay work plan with effective community participation. It deals with all the three parameters of sustainability: social, economical, and environmental issues very critically.

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Study on the Effect of Different Urea Fertilizer Rates and Plant Populations on the Severity of Bacterial Blight (BB) of Rice

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Abstract

To study the effect of different urea fertilizer rates and plant populations on disease severity of bacterial blight of rice and yield lasses related to disease, the experiments including three plant populations (110000, 150000, 190000) and five urea fertilizer rates (0,56 lb, 112 lb, 168 lb and 224 lb per acre) were conducted at Central Agriculture Research Institute farm in 1999 and 2000 rainy seasons. Manawthukha was used as a test variety that is susceptible to bacterial blight of rice. The disease severity could be increased by the application of urea. Although urea 112 lb per acre gave moderate disease severity than without urea, its yield is highest. The higher disease severity also showed the related effect of plant population of 150000 and above. However the combination of urea 224 lb per acre with the population of 190000 and 150000 gave the highest severity of bacterial blight disease and the minimum grain yield. The application of urea 224 lbs per acre can cause yield reduction ranging from 18.67 percent to 27.57 percent over the application of urea 112 lb per acre.

Keywords: rice, bacterial blight, fertilizer rates, urea, plant density

1 Introduction

Bacterial blight (BB) caused by *Xanthomonas oryzae* pv. *oryzae* is one of the major diseases of rice in rice -growing countries of Asia. Yield losses in severely infected fields ranged from 20 % to 30 % (Ou, 1985) and data showed that yield loss may reach about 81 % (Singh *et al.*, 1977). Bacterial Blight disease on rice was reported from Japan and the Philippines almost seventy five years ago. Now this disease is found to occur all over the country in many of exotic and indigenous rice varieties, and is considered a severe menace to rice production in Myanmar. The varieties, Manawthukha (Mahsuri M), Shwewatun (IR 5 Mutant), Manawhari (Mahsuri), Kyawzeya, Inmayebaw, Yebawlatt

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(Photosensitive) and Ayeyamin which occupy about 50 % of the area sown in rainy season are susceptible to bacterial blight disease. The major problems to increase disease are cultivation over a large acreage of susceptible varieties, use of rice after rice cropping pattern, heavy application of nitrogen fertilizer and planting of dense population. The experiments were, therefore, conducted to know the effect of different rates of urea fertilizer and different plant populations on the severity of Bacterial Blight disease and yield loss related to disease.

2 Materials and Methods

2.1 Field experiment

The experiments were conducted in the field of Plant Pathology Division, Central Agriculture Research Institute, Yezin during 1999 and 2000 rainy seasons. The experimental plots were laid out in strip plot design with three replications.

Five urea fertilizer rates (0,56 lb, 112 lb, 168 lb, and 224 lb/ac) and three plant populations [110000 (9" $\times$6"), 150000 (8" $\times$5") and 190000 (8" $\times$4")] were used as horizontal factor and vertical factor respectively. The plot size for each treatment was 12 $\times$ 10 feet.

2.2 Test Variety

Manawthukha that is susceptible to bacterial blight disease was used as a test variety.

2.3 Fertilizer application

Triple super phosphate (TSP), muriate of potash (MOP) and gypsum at the rate of 56 lb, 56 lb and 100 lb/ac were respectively used as basal application at land preparation. 1/2 dose of urea for each treatment was used as basal and the remaining 1/2 dose was used at maximum tillering stage. Proper controls were maintained throughout the course of these experiments.

2.4 Disease evaluation

Disease evaluation was made by measuring disease severity (the area affected plant tissue expressed as a percentage of total area assed). The disease severity of natural infestation was scored at booting stage according to the Standard Evaluation System of IRRI (1996).

Table 1: Disease severity standard evaluation system of IRRI (1996)

Disease score	*Lesion area (%)*	*Disease reaction*
1	1-5	R
3	6-12	MR
5	13-25	MS
7	26-50	S
9	51-100	HS

2.5 Yield data

At harvest, filled grains per panicle, unfilled grains per panicle, thousand-seed weight, yield per plot and yield per acre were measured.

2.6 Data analysis

Data were statically analysed by using standard analysis of variance and means were separated with Duncan's multiple range test as described by STEEL and TORRIE (1981).

3 Results

The results of 1999, rainy season experiment are shown in Table 2. At the different rates of urea, although filled grains per panicle, unfilled grains per panicle and thousand-seed weight were not significantly different, disease score and yield per acre were differing statistically significant form control (Table 2).

Table 2: Effect of different rates of urea fertilizer and different plant populations on disease severity of BB and yield of *Manawthukha* (rainy season, 1999).

Treatments	Disease score	filled grains per panicle	unfilled grains per panicle	1000 seed wt (g)	Yield (bsk/ac)
Urea rates					
0	1.64 ^{d}	83.58 ^{a}	20.10 ^{a}	18.92 ^{a}	71.32 ^{c}
56 lb/ac	2.62 ^{c}	88.26 ^{a}	24.10 ^{a}	19.01 ^{a}	87.37 ^{ab}
112 lb/ac	3.84 ^{b}	101.47 ^{a}	25.42 ^{a}	19.31 ^{a}	91.28 ^{a}
168 lb/ac	4.80 ^{a}	92.20 ^{a}	25.58 ^{a}	19.12 ^{a}	81.41 ^{abc}
224 lb/ac	4.89 ^{a}	94.64 ^{a}	26.90 ^{a}	19.47 ^{a}	76.92 ^{bc}
r	+0.984	-0.611	+0.913	+0.855	-0.702
Plant Population					
9"×6" (110000)	3.20 ^{a}	99.41 ^{a}	24.42 ^{a}	19.27 ^{a}	81.49 ^{a}
8"×5" (150000)	3.41 ^{a}	87.48 ^{b}	23.79 ^{a}	19.19 ^{a}	84.91 ^{a}
8"×4" (190000)	4.07 ^{a}	89.19 ^{b}	25.05 ^{a}	19.04 ^{a}	78.53 ^{a}
r	+0.85	-0.792	+0.500	-0.990	-0.611
CV%	17.97	9.29	9.51	4.81	10.20

Values followed by the same letter are not signiflcantly different ($P = 0.05$) according to Duncan's multiple range test.

BB disease scores of different rates of urea were higher than that of control plot (without application of urea). The rates of urea 168lb per acre and 224lb per acre gave the most severe disease damage (Table 2). The best yields were obtained in the use of urea 56 lb and 112 lb per acre. The application of urea 168 lb and 224 lb per acre showed lesser yield than the application of urea 112 lb per acre (Table 2).

In the case of plant population, the disease severity and yield were not significantly difference among treatments. However, the dense plant population (190000) gave the

highest disease score and the minimum yield among all plant populations tested (Table 2).

Highly significant correlations were obtained between different rates of urea and disease score ($r = +0.98$), untilled grains per panicle ($r = +0.91$) as well as between plant populations and disease score ($r = +0.85$). Different urea rates and plant populations also showed weakly significant negative correlation with filled grains per panicle ($r = -0.61$). Thousand-seed weight showed positive correlation with different urea rates, whereas that showed negative correlation with plant populations.

The results of 2000 rainy season experiment were presented in Table 3. The results showed that statistical analysis of disease score, Thousand-seed weight, unfilled grain per panicle and yield per acre were significantly different among different urea rates. The application of urea 168 lb and 224 lb per acre indicated the highest disease severity, increase number of unfilled grains per panicle, and reduction of yield per acre (Table 3).

All parameters recorded were not significantly different among plant population except disease score. The population of 150000 and 190000 gave the enhanced disease severity (Table 3).

Table 3: Effect of different rates of urea fertilizer and different plant populations on disease severity of BB and yield of *Manawthukha* (rainy season, 2000).

Treatments	Disease score	filled grains per panicle	unfilled grains per panicle	1000 seed wt (g)	Yield (bsk/ac)
Urea rates					
0	5.56 ^{d}	77.56 ^{a}	18.99 ^{b}	19.59 ^{a}	71.22 ^{bc}
56 lb/ac	7.62 ^{c}	77.87 ^{a}	27.90 ^{ab}	18.98 ^{b}	90.05 ^{a}
112 lb/ac	7.73 ^{c}	77.66 ^{a}	29.19 ^{ab}	18.42 ^{b}	87.28 ^{a}
168 lb/ac	8.26 ^{b}	74.77 ^{a}	35.98 ^{a}	18.44 ^{b}	76.92 ^{b}
224 lb/ac	8.99 ^{a}	69.92 ^{a}	35.37 ^{a}	18.39 ^{b}	68.42 ^{c}
r	0.99	-0.83	0.94	0.46	-0.51
Plant Population					
9"×6" (110000)	7.45 ^{b}	76.75 ^{a}	29.86 ^{a}	18.99 ^{a}	79.54 ^{a}
8"×5" (150000)	7.66 ^{a}	74.92 ^{a}	29.63 ^{a}	18.46 ^{a}	77.81 ^{a}
8"×4" (190000)	7.78 ^{a}	73.79 ^{a}	28.96 ^{a}	18.84 ^{a}	78.97 ^{a}
r	0.98	-0.99	0.84	-0.89	-0.61
CV%	1.95	11.88	16.18	2.92	2.93

Values followed by the same letter are not signiflcantly different ($P = 0.05$) according to Duncan's multiple range test.

The results of interaction between different rates of urea and plant populations on the severity of bacterial blight of rice were shown in Table 4 and Table 5.

Table 4: Interaction between different rates of urea fertilizer and different plant populations on disease severity of BB disease (rainy season, 1999).

Urea rates	*Disease score*			*Mean*
	Plant populations			
	110000 (9"×6")	*150000 (8"×5")*	*190000 (8"×4")*	
0	1.20 ^{h}	1.33 ^{gh}	2.40 ^{fg}	1.64 ^{d}
56 lb/ac	2.13 ^{fgh}	2.53 ^{f}	3.20 ^{ef}	2.62 ^{c}
112 lb/ac	4.27 ^{bcde}	3.33 ^{def}	3.93 ^{cde}	3.84 ^{b}
168 lb/ac	4.53 ^{abcd}	4.60 ^{abc}	5.27 ^{ab}	4.80 ^{a}
224 lb/ac	3.87 ^{cde}	5.27 ^{ab}	5.53 ^{a}	4.89 ^{a}
Mean	3.20 ^{a}	3.41 ^{a}	4.06 ^{a}	
CV%				17.97

Table 5: Interaction between different rates of urea fertilizer and different plant populations on disease severity of BB disease (rainy season, 2000).

Urea rates	*Disease score*			*Mean*
	Plant populations			
	110000 (9"×6")	*150000 (8"×5")*	*190000 (8"×4")*	
0	5.20 ^{h}	5.60 ^{g}	5.87 ^{f}	5.56 ^{c}
56 lb/ac	7.43 ^{e}	7.70 ^{de}	7.73 ^{cd}	7.62 ^{b}
112 lb/ac	7.67 ^{de}	7.67 ^{de}	7.87 ^{cd}	7.73 ^{b}
168 lb/ac	8.00 ^{c}	8.33 ^{b}	8.43 ^{b}	8.26 ^{a}
224 lb/ac	8.97 ^{a}	9.00 ^{a}	9.00 ^{a}	8.99 ^{a}
Mean	7.45 ^{b}	7.66 ^{a}	7.78 ^{a}	
CV%				18.5

The combined use of urea 224 lb per acre with 190000 plant populations gave the highest disease score followed by urea 224 lb per acre with 150000 plant population and urea 168 lb per acre with 190000 plant populations (Table 4). Urea 168 lb per acre and 224 lb per acre gave highly susceptible reaction among all plant population (110000, 150000, 190000) tested (Table 5). The lowest disease score was obtained in the non application of urea with 110000 plant populations (Table 4 and 5).

The results shown in Table 6 and 7 indicated the interaction between different rates of urea and plant populations on yield per acre of Manawthukha variety. Urea 112 lb per acre gave the best yield (95.37 baskets) combined with the population of 150000 and 93.25 baskets combined with 110000 plant populations. Urea 56 lb per acre combined with 110000 plant populations also gave 92.38 baskets per acre (Table 6). Besides, urea 56 lb per acre gave the best yield (95.08 baskets / ac) application with 110000 plant populations (Tab1e 7). However, the used of without urea, urea 168 lb per acre and 224 lb per acre gave the lowest yields among three plant populations tested (Table 7).

Urea 168 lb and 224 lb per acre caused the yield reduction of 12.12% and 18.67% in 1999 rainy season experiment and of 13.46% and 27.57% in 2000 rainy season experiments respectively over the application of urea 112 lb per acre (Table 8).

Table 6: Interaction between different urea rates and plant populations on yield (bsk/ac) of *Manawthukha* (rainy season, 1999).

Urea rates	*Yield (bsk/ac)*			*Mean*
	Plant populations			
	110000 (9"×6")	*150000 (8"×5")*	*190000 (8"×4")*	
0	63.61 ^{d}	84.82 ^{abc}	65.52 ^{d}	71.32 ^{c}
56 lb/ac	92.38 ^{ab}	85.66 ^{abc}	84.08 ^{abc}	87.37 ^{ab}
112 lb/ac	93.25 ^{ab}	95.37 ^{a}	85.23 ^{abc}	91.28 ^{a}
168 lb/ac	78.26 ^{bcd}	79.37 ^{abcd}	86.35 ^{abc}	81.41 ^{abc}
224 lb/ac	79.95 ^{abcd}	79.34 ^{abcd}	71.46 ^{cd}	76.92 ^{bc}
Mean	81.49 ^{a}	84.91 ^{a}	78.53 ^{a}	
CV%				10.20

Table 7: Interaction between different urea rates and plant populations on yield (bsk/ac) of *Manawthukha* (rainy season, 2000).

Urea rates	*Yield (bsk/ac)*			*Mean*
	Plant populations			
	110000 (9"×6")	*150000 (8"×5")*	*190000 (8"×4")*	
0	68.82 ^{g}	69.60 ^{g}	75.21 ^{f}	71.22 ^{bc}
56 lb/ac	95.08 ^{a}	88.96 ^{bc}	86.12 ^{cd}	90.05 ^{a}
112 lb/ac	86.84 ^{bcd}	84.19 ^{d}	90.81 ^{b}	87.28 ^{a}
168 lb/ac	77.73 ^{ef}	79.41 ^{e}	73.61 ^{f}	76.92 ^{b}
224 lb/ac	69.22 ^{g}	66.91 ^{g}	69.14 ^{g}	68.42 ^{c}
Mean	79.54 ^{a}	77.81 ^{a}	78.97 ^{a}	
CV%				2.92

Table 8: Yield of *Manawthukha* affected by different rates of urea related to disease severity of bacterial blight.

Urea rates	*1999, rainy season*		*2000, rainy season*	
	Yield (bsk/ac)	*% of yield decrease over 112 lb urea per ac*	*Yield (bsk/ac)*	*% of yield decrease over 112 lb urea per ac*
0	71.32	27.99	71.22	22.54
56 lb/ac	87.37	4.48	90.05	+3.07
112 lb/ac	91.28	0.00	87.28	0.00
168 lb/ac	81.41	12.12	76.92	13.46
224 lb/ac	76.92	18.67	68.42	27.57

4 Conclusion

Based on the results from these observations, it can be concluded as follows:

(1) The disease severity of bacterial blight of rice could be increased by the application of nitrogen fertilizer.

(2) Use of higher level of nitrogen fertilizer can cause the higher disease severity of bacterial blight of rice.

(3) Maximum yield with minimum level of disease severity could be obtained with the use of:
urea 56 lb per acre with a population range from 110000 to 150000 plants per acre (or) urea 112 lb per acre with 150000 plant population.

(4) To maintain a tolerable disease severity and to minimize yield losses, the use of urea above 112 lb per acre should be avoided.

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A Research on the Impacts of Tourism on Rural Household Income and Farm Enterprises: The Case of the Nevşehir Province of Turkey

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Abstract
This article is aimed at investigating the impact of tourism activities on the income and living conditions of rural households, and reflecting the views of both households and tourists on tourism related activities. An economic assessment of households that deal both with agriculture and tourism in the Nevşehir Province (Cappadocia) has been carried out based on primary survey data. Agriculture is the main economic activity in Nevşehir, and households generally have the characteristic structure of small family enterprises. While 59.8% of household labour forces are utilised in agriculture, 7.0% are engaged in tourism activities. The agricultural and tourism related activities, such as pottery making, handicrafts and lodging, are often in competition for the generally insufficient working capital of households, as well as time and labour. Total average household income in the region has been determined as $9,949, of which $7,315 (73.5%) is drawn from agriculture and $2,587 (26%) from tourism-related activities. Tourism cannot be regarded as an activity that constitutes an alternative to agriculture, but rather a complementary source of income.

Keywords: rural tourism, income and employment benefits, complementary activities, Cappadocia (Turkey)

1 Introduction

Turkey is a transitioning economy, with 35% of the population living in rural areas and 30% of the labour force involved in agriculture, which contributed only 11.4% to Gross Domestic Product (GDP) in 2005 (SPO, 2005). The Turkish economy exhibits the characteristics of a developing economy based on per capita income, economic growth, employment, income distribution, foreign trade volume and economic structure (Tanrivermiş and Bülbül, 2007). Turkey, beginning in the second half of the 1980s, has become a well-known and preferred holiday and travel destination. While in 1980

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foreign tourists numbered 1.29 million and total income from tourism was $326 million, in 2005 the number of tourists reached 21.12 million, generating income of $13,929 million. Turkey's share of total international tourism income is estimated to be around 2% (TÜRSAB, 2006). According to 2005 data, tourism in Turkey accounted for 5.5% of the national income, employing 5.1% of the population directly and 12.8% indirectly (OECD, 2006). It must be noted, however, that only foreign tourism is taken into consideration in the calculation of the contribution of tourism to the national economy, so domestic tourism is not reflected in these figures and the contribution of tourism to the national income will clearly be higher when domestic tourism is also taken into consideration. Tourism is an important sub-sector for Turkey in terms of foreign currency income, its effects on the payments balance, as well as its contribution to employment rates and other sectors.

There is a tendency in rural areas for the majority of people to look for secondary sources of income due to high levels of unemployment, low living standards and an increasing inequality in income and farmland distribution. Thus, it is necessary to identify some opportunities in the initiation of specific businesses in rural areas which may supplement the farmers' incomes, thus motivating the workforce to remain in their villages. Tourism is noted as one of the major income generating activities in rural Turkey, as mentioned in Turkey's Development Plans (SPO, 2000). For example, in the 8th Five-year Development Plan (2001-2005) it is stated, "In order to increase the income of the rural population and reduce unemployment, entrepreneurs shall be supported in fields with local potential, such as tourism, handicrafts, animal husbandry and weaving" (SPO, 2000).

Agriculture is the core activity for virtually all rural households, although livelihood strategies differ from region to region and from household to household. On a national scale, the ratio of households in which agricultural activity is the sole source of income is 86.32%, while 6.83% are involved in agriculture as a main source with additional income coming from a secondary activity. For Nevşehir, the ratio of households with a main occupation in agriculture is 92.24%, while those with agriculture as a main source but with a non-agriculture related secondary occupation account for 5.20% (SIS, 2004). In numerous developing and developed countries demand for rural tourism is rapidly increasing, and tourism is being regarded as a tool for rural development in agricultural policies. Under these circumstances, in rural areas tourism contributes to an increased level of income and to growth of employment opportunities as a significant developmental factor that is complementary to agriculture. This is the case particularly in regions where agricultural structures and natural, historical, and cultural resources exist. On the other hand, tourism-oriented activities in rural areas can have both positive and negative impacts on both households and rural communities, and rural development activities aim to maximise positive contributions to the highest extent possible.

Studies into rural tourism and the impact of this activity on rural households and small family farms are very limited in Turkey, which is the case with many other countries. In fact, the social, economic and environmental impacts of rural tourism have been studied only since 1990. Recent researches have focused on the importance of tourism

in the development and socio-economic change in rural areas based on impact assessments through the expenditure analysis of individual or group tourists in rural areas (Mathieson and Wall, 1982; Butler, 1990; May, 1991; Fleischer and Pizam, 1997; Katenholz *et al.*, 1999; Esengün *et al.*, 2001). There are concerns regarding the impact that tourism has on natural resources from the viewpoint of air and water, flora and fauna, non-agricultural use of productive land, and aesthetics, among others (Johnson and Moore, 1993; Bontron and Lasnier, 1997). Although tourism has its share of negative environmental consequences, it can also have a positive impact on the environmental and socio-economic structure of rural areas. The development of rural tourism provides new opportunities for farm operators and workers, and creates stronger linkages between vacation farms and public spaces, and further investigation into the relationship between wildlife study, hunting activities and handicrafts (Schneider, 1993; Fennell and Weaver, 1997; Ashley, 2000).

The assessment of the economic impacts of tourism activities attempts to place a monetary value on a particular event, business or sector of an economy. Direct impacts include the actual revenues generated by the activity at locations throughout the community. Indirect impacts cover additional input purchases made by local business as a result of the event (Woods and Barta, 2002). Previous studies related to an impact assessment of tourism industry have been based on the measurement of visitors' expenditures in rural and urban areas by using time-series or cross-sectional data (Mak *et al.*, 1977; Dardis *et al.*, 1981; Mathieson and Wall, 1982; Lieber and Fesenmaier, 1989; May, 1991; Johnson and Moore, 1993; Dardis *et al.*, 1994; Taylor *et al.*, 1993; Schneider, 1993; Fleischer and Pizam, 1997; Slee *et al.*, 1997; Leones, 1998; Katenholz *et al.*, 1999; Ashley, 2000). Distinct from previous studies, this research aims to investigate the effects of tourism activities on the income and living conditions of households through income analyses. Competitive relationships are likely to occur between agricultural and tourism activities in terms of use of land resources, and the demand for manpower and capital. In Turkey, there is significant potential for mountain, plateau and agricultural tourism in both the coastal and inner regions. The province of Nevşehir, which was examined as a case study in the research, has a high potential for rural tourism.

2 The Data and Methodology

The primary method for assessing the direct impact of an event is to conduct a survey of a different group of participants (Leones, 1998; Woods and Barta, 2002). The material for the research comprises survey data gathered from households engaged in both tourism-oriented and agricultural activities together in the Ürgüp and Avanos districts of the Nevşehir Province. Previous studies on the subject and related literature have also been utilised. Data from the Provincial/District Directorates of Agriculture, Culture and Tourism, and the State Institute of Statistics related to the agriculture and tourism potential of the study region have also been utilised. The survey form used in the research was prepared in line with the goals of the study, and the relevance of these forms to the region was validated through an earlier test survey carried out in the

region. The data used in the study was collected through a questionnaire covering the 2001-2002 production period.

The households that carry out both agricultural and tourism activities in the Nevşehir province are situated mostly in the districts of Avanos and Ürgüp. Using the results obtained from the pre-studies carried out in the region, as well as the records of the Provincial Directorates of Agriculture, Culture and Tourism, the villages and enterprises that mainly carry out agricultural and tourism-oriented activities together have been identified. In a total of seven villages, three located in the district of Avanos and four in the district of Ürgüp, it has been found that enterprises, alongside agricultural activities, are largely involved in tourism-oriented activities, which include provision of accommodation (hotels, motels and lodging houses), production and sale of souvenirs, production and sale of pottery and earthenware, restaurants and amusement facilities. The survey was administered in a total of seven villages on 55 households identified as carrying out both agricultural and tourism-oriented activities concurrently. The months in which domestic and foreign tourists visit the Cappadocia Region most were identified, and a quick assessment survey was conducted on domestic and foreign tourists visiting the study area for one week periods. In the lodging enterprises and sightseeing areas, the survey was administered to 114 foreign tourists and to 100 domestic tourists. All the participants that visited the area in the examined period were included in the interviews. In the survey phase of the study, those visiting the region were approached and their reasons for visiting and satisfaction levels were assessed. The months/seasons, in which foreigners and domestic tourists visit the region were comparatively examined. In particular, the possible negative impacts of overcrowding, the capacity of the facilities and the intense utilisation of the natural resources and on the income and living conditions of those living/working in the region were assessed. The opinions of domestic and foreign tourists have been considered together due to the similarity, to a great extent, of results.

In the analysis of the economic structure of the households, a whole analysis was employed (Açıl and Demirci, 1984; Erkuş *et al.*, 1995; Turner and Taylor, 1998), and thus the contribution of agriculture and tourism activities to the revenues and living conditions of families have been evaluated by comparing these values to household averages. The adequacy of the identified average farm incomes of households are comparatively examined using the sufficient farm income scale, as defined by the Law on Agricultural Reform on Land Usage in Irrigation Areas, dated 1983, and with issue number 3083. In addition to the economic analysis, the contributions and/or burden imposed by agriculture and tourism activities on the domiciles and the region on a per household basis; why domestic and international tourists prefer rural areas, as well as the times spent and expenditures made in rural areas; the most appealing resources in rural areas; infrastructure and tourism relations in rural areas; and the inclinations and expectations of households regarding the improvement of tourism activities in rural areas have been examined using the gathered data obtained from the questionnaire, which included open-ended and multiple choice questions.

3 Research Results and Discussions

3.1 Description of the Research Area

The province of Nevşehir, the research district, is located in the Central Anatolia Region (FIGURE 1). The Cappadocia Region covers Ürgüp, Göreme, Avanos and Ihlara and is the most important touristic region of the Nevşehir Province. There is a vast area coated with tufa and lava expelled by Mount Erciyes in the mountainous areas, where chimney rock formations and erosion-induced valleys are prominent. Tourism activities in the province of Nevşehir have been identified as agricultural tourism, cultural tourism, nature tourism, plateau tourism, handicrafts, cave tourism and gastronomy tourism according to district. Investments in the areas determined to have promising tourism potential in individual districts will lead to the integration of tourism activities into the rural areas with the present potential of sources (Table 1). Thanks to the volcanically-formed caves and "chimney rock" formations, nature tourism has evolved considerably. It is a fact that rural and urban households have the opportunity to benefit from tourism when they focus on areas where this potential is present.

Figure 1: Location of the Research Area

The province of Nevşehir is visited annually by 1,011,933 people, 393,728 of which are domestic tourists and 618,205 of which are foreign (SIS, 2003; TÜRSAB, 2006). In the province, especially in the districts of Avanos and Ürgüp, agriculture and tourism constitute two important main sources of income for the rural community. Motel and lodging house businesses, and the production and sale of souvenirs, are intensive practices in these two districts. In addition, places manufacturing and selling souvenirs, earthenware and ceramic workshops, restaurants and amusement centres are all active (Koyuncu and Yilmaz, 2002). There is also a high agricultural potential in Nevşehir. The total area of the province is 546,693 ha, of which 341,593 ha is farmland. The share of farmland in the total area of the province is 62.5%, whereas this ratio is 71.2% in Ürgüp and 43.8% in Avanos. In the farms, both crop and livestock-related production are generally carried out together, and produce from the farms and structures are used for tourism-oriented purposes to some extent (SIS, 2004, 2005).

Table 1: Sources of Tourism and Opportunities in Nevşehir

Types of Tourism	*Districts of the Provinces of Nevşehir*						
	Avanos	*Bozca*	*Çavuşin*	*Ürgüp*	*Mustafapaşa*	*Ortahisar*	*Karakaya*
Agricultural Tourism	X	X	X	X	X	X	X
Cultural Tourism	X	X	X	X	X	X	–
History Tourism	X	–	X	X	X	X	–
Nature Tourism	X	–	X	X	X	–	–
Plateau Tourism	–	X	X	–	–	–	X
Handicrafts	X	X	X	X	X	–	X
Cave Tourism	X	X	X	X	X	X	X
Gastronomy Tourism	X	–	X	–	X	X	–
Lodging House Business	X	–	–	X	X	X	–
Faith Tourism	X	–	X	X	X	X	–

(X) Shows places with tourism potential and (-) places without an identified significant potential.

The economy of the district depends largely on agriculture, tourism and carpet manufacture. Potatoes and wine are the famous regional products of Nevşehir. Carpet manufacture is a traditional profession, carried out using home looms in the villages. Industry mainly comprises wine, grape molasses, marmalade, floor tile and souvenir production. Tourism is the second most important source of income for the economy of the district. The Göreme Historical National Park and the wine houses in the area are important aspects of tourism for Göreme. Traditional handicrafts, carpet weaving, ceramic production (which has been maintained since the Hittite civilisation) and pottery workshops are famous characteristics of Avanos. There are accommodation facilities such as hotels, motels, and lodging houses in the districts. The production of wine grapes and the importance of the wine culture throughout its historical development process led to the selection of the districts as a preferred location for the establishment of wine factories (Kaya, 1981; Nevşehir Governorship, 1997, 1998, 2002).

3.2 Population and Idle Labour Forces in Nevşehir and the Surveyed Households

The population of the province is 309,914, with an average population density of 58 people per square km, of which 55.9% live in rural areas. The share of rural population in the total is 72.4% in Ürgüp and 61.8% in Avanos (SIS, 2003). Tourism and other non-agricultural activities are gaining importance in terms of the reduction of population pressure on the land, the prevention of destruction of natural resources, the reduction in unemployment, and the increase of income in rural areas.

The average population per household is 4.15 people, with the economically active population (of age 15-65) holding an important share (74.5%). The leading underlying factor restricting the development of tourism in rural areas is the scarcity of a qualified labour force. It is determined that 6.5% of the population within the households is illiterate,

whereas 2.7% are literate, 67.2% are primary school graduates, 12.3% are secondary school graduates, 9.9% are high school graduates, and 1.4% possess an associate or bachelor's degree. It has been found that 93.5% of the population at or above the age of six is literate, which is higher than the national average of 80.0%.

The primary source of employment in the villages is farming. Within the households surveyed, 66.9% of the present labour force is utilised in agricultural and non-agricultural activities. The rate of idle labour force is 33.1% overall in the average household. Additionally, 59.8% of the existing labour force is utilised in agricultural activities and 7.0% is engaged in tourism-oriented activities. In order to reduce the amount of idle labour force in enterprises, other activities such as craftsmanship and animal husbandry, as well as publicity activities that may improve winter tourism, should be augmented.

While 33.1% of the labour force is idle, 30.1% of the demand for labour force in agricultural and tourism activities is met by hired labour from outside the region. Hired labour employed in agriculture and tourism is generally male and well-educated, and are employed in tourism oriented activities. This is mainly because the households are inexperienced in conducting agricultural and tourism activities together, and therefore the labour force is not distributed evenly among the activities. Two other important factors are that the households cannot transfer enough labour force to agriculture when demand arises, and that the family labour force is not distributed between the two activities in a balanced way. In addition, the fact that young individuals with a relatively higher level of education and competence in foreign languages are employed in tourism activities, and that the families lack members with the necessary qualifications, make employment of imported labour compulsory.

The survey was conducted on all of the households in seven settlements, where households that carry out both agriculture and tourism-related activities constitute the majority. The share of the households on which the survey was conducted to the total number of households in the study region remained below 1% (Table 2). This ratio shows that the households that carry out both agriculture and tourism-related activities are not dominant in terms of numbers, and that it has not been possible to disseminate tourism oriented activities in rural areas. According to the producers who are not actively oriented towards tourism activities in rural areas, factors such as the insufficiency of qualified labour, inadequate building assets, and insufficient working capital have been given as the main reasons for not diversifying.

3.3 Assets and Incomes of the Rural Households

Some 86.1% of the total assets of the households consist of fixed assets, whereas 13.9% consists of working capital. Land and building capital has the highest share among total assets, with 51.9% and 30.1% respectively. When the scarcity of working capital in the examined households is taken into consideration, competition is likely to occur between agricultural and tourism activities in terms of meeting the demands for working capital. On the other hand, while tourism activities can satisfy the demand of agricultural activities for working capital, the sales revenue of farm produce can satisfy the demand of tourism activities for working capital. However, the harvesting and sale of such products

Table 2: Number of Surveyed and Total Households in the Settlements of the Research Area.

Districts	*Settlements*	*Number of Surveyed Households*	*The Total Number of Households in Settlements*	*Ratio (%)*
Avanos	Bozca	13	167	7.78
	Çavuşin	9	180	5.00
	Merkez	18	2,614	0.69
Ürgüp	Mustafapaşa	3	470	0.64
	Ortahisar	3	1,025	0.29
	Karakaya	1	60	1.67
	Merkez	8	3,786	0.21
Total		55	7,278	0.66

as grapes (wine) and potatoes, for which 24.6% of the operating farmland is set aside, takes place in the autumn, and therefore only the sales revenue from cereals, for which 70.7% of the land is set aside, and milk and other animal products, which constitute 17.8% of the total gross production value, will be available to meet the demand of tourism activities for working capital.

The average gross production value of the households is $14,791, 85.2% and 14.8% of which are crop and livestock production values respectively. In crop production, potatoes make the highest contribution to the gross production value (55.6%), followed by cereal production with 28.1%. The activities of dairy production and cattle rearing, as well as sheep husbandry, are limited within the households, with the limited produce gained from these activities used to satisfy the demands of the family members and for livestock accommodation. As crop production exceeds the demands of the families and the lodging houses, these products are offered for sale in the market. The net return within the households is $6,781, of which the gross production value is 45.9%. The households generally earn positive interest revenue for the total assets they invest into agriculture.

A farm's income is an important indicator, especially of the success of the entrepreneur (Açıl and Demirci, 1984; Erkuş *et al.*, 1995; İnan, 1998). The average farm income of the households surveyed is $7,315, which is higher than the sufficient farm income ($3,329) as defined by Law, no. 3083, dated 1983. Off-farm income earnings from tourism, pensions, salaries, wages, and direct income support are determined to be $2,633. The total household income is $9,949, and since the average family size is 4.15 persons, per capita income is calculated as $2,397 (Table 3). The annual average income of the households has been found to be 8.4% lower than the per capita national income ($2,598), and 118.0% higher than the rural average ($1,099) in the same period. In the examined villages, the calculated and declared average incomes of the households engaged in tourism-oriented activities are generally higher than those of the households in the same villages who are not engaged in tourism-oriented activities. Since only a small

number of the households in the villages are engaged in tourism-oriented activities, the socio-economic effects of tourism, such as income generation, employment, prevention of migration, and regional development, remain limited in the rural areas.

Table 3: Farm, Off-farm and Total Incomes and Expenditures of the Households.

Sources of Income	*Value ($)*	*Rate (%)*
Agricultural (Farm) Income	7,315.48	73.53
Income from Tourism-oriented Activities	2,585.51	25.99
• Pottery business	1,425.05	14.33
• Handicrafts business	253.00	2.54
• Household lodging business	907.46	9.12
Pensions, Wages, and Fees	1.84	0.02
Direct Income Support Payments	45.78	0.46
Total Household Income	9,948.61	100.00
Total Expenditure	7,506.13	75.45
Total Savings	2,442.38	24.55

The share of farm income in the total family income is 73.5%, whereas that of tourism-oriented activities is 26.0%, and that of pensions, wages, fees and direct income support is 0.5%. The contribution of pottery businesses to the household income is 14.3%, that of handicrafts is 2.5% and that of boarding house businesses is 9.1%. It has been determined that the households earn 2.8 times more income from farming as from tourism activities.

The best indicator in an analysis of household livelihoods would be an evaluation of expenditures per household and per capita. The average annual livelihood and housing expenditures of households have been investigated as an indicator of living standards. The annual average housing and current expenditures of the households are found to be $7,506. The difference between the consumption expenditures and income in households yields the amount of savings, whereas the ratio of the mean savings to total household income reflects the tendency to save money. In addition, it can be seen from the survey that households save 24.6% of their annual average income, above the average for rural areas. The average savings tendency of the households is considerably higher than the national average, as well as the average of rural areas.

3.4 Time Schedule, Nationalities and Expenditures of Tourists Visited Research Area

The surveyed households have been living in this region for 43 years and have been performing both agricultural and tourism activities concurrently for 17 years. Tourism is a relatively new rural activity for local people when compared to agriculture and handicrafts, is correctly perceived as a less risky activity, and is seen as an opportunity

for additional income to combine with existing livelihood activities, not a substitute (Ashley, 2000). Thus, the way in which tourism complements or conflicts with existing activities has appeared as a key restriction in household decisions.

Some 89.0% of the rural households stated that more foreign and local visitors come to the region in the summer season, while 11.0% believe that more visitors come to the region in the spring and autumn. The summer season is the most suitable period for tourism, and is the time during which people prefer to take their vacations. Although many people state that Nevşehir is suitable for tourism both in summer and winter, it is a known fact that especially Japanese tourists prefer to visit the region in the winter months.

The distribution of foreign tourists on whom the survey was conducted, according to nationalities, and the times when domestic and foreign tourists visit the Cappadocia Region, were examined. Of these, 89.0% of the foreign tourists visited the region in the summer, stating that this was the most suitable season for tourism, while 9.0% believed that the Cappadocia Region may be suitable for tourism both in summer and winter, and particularly Japanese tourists preferred coming in the winter. The remaining 2% stated that they have visited or would visit the region at any time during the year, and that they had no seasonal preference of when to make their visits. In the lodging enterprises and sightseeing areas, of the 114 foreign tourists surveyed, most of the visitors came from the Netherlands (30%), Russia (22%) and Great Britain (14%) (Table 4). However, these ratios would be expected to change if regular monthly surveys were to be conducted throughout the year.

Table 4: Nationalities of Surveyed Foreign Tourists and Periods of Visit.

The Nationality of Tourists	*The Number of Surveyed Foreign Tourists*		*Frequently Visiting Periods (Months)*
	Number	*Ratio (%)*	
Japan	11	9.32	October-May
German	14	11.86	May-November
UK	16	13.56	June-December
The Netherlands	35	29.66	June-December
Russia	26	22.03	May-December
France	12	10.17	May-November
Total	114	100.00	–

Domestic tourists generally conduct their visits in the March-May and October-December periods, the majority choosing to come twice a year. The fact that domestic and foreign tourists choose to come to the Cappadocia Region in the same periods imposes a pressure on the natural resources and environment, causing crowding and putting pressure on the inadequate infrastructure. On the other hand, increased tourism contributes positively to the increase in employment and income levels of the households. The particular suitability of the summer months for tourism leads to an increase of visitors in

these months. There is a requirement to augment promotional activities aimed at the development of winter tourism in the region, as well as the frequency of domestic and foreign tourists.

Tourism can have significant benefits for farmers and rural communities as a whole, providing opportunities for diversification and economic incentives for producers, thus promoting economic growth. The income potential from tourism depends on the timing and expenditure of the individual tourist. The majority of tourists generally prefer to stay in hotels (47%), while 36% prefer lodging houses, and the remaining 17% prefer private accommodation. The average preferred length of stay in the area is 2-4 nights, with an average expenditure per night of $47.0 per person for foreign tourists. Tourism revenues can be improved by increasing the number of visitors, or the length of stay of each visitor. Local tourists visit the region generally for weekend holidays or when passing through the region on their touring routes. The average lodging period of the domestic tourists is 2.1 days. The per capita expenditures of domestic tourists ($44.5 per person) are quite close to those of foreign tourists. Although the time spent by foreign tourists in the region is longer than the time spent by the domestic tourists, their spending is nearly at the same level.

3.5 Annual Tourism Activities, Relations with Agriculture and Frequently Visited Locations

Tourism can conflict with existing activities by reducing access to natural resources, creating a conflicting demand on time and working capital. The compatibility of agricultural and tourism activities has been evaluated by examining the seasons in which more foreign and domestic tourists visit the region. The amount of time demanded by tourism is the most important conflict with agriculture from the viewpoint of labour allocation. As tourism activities intensify in the summer months (April to September), households involved in both agricultural and tourism activities suffer problems in the utilisation of their labour force. The increase in demand on the labour force for agriculture (especially cereal, potato and viniculture) and tourism activities in the summer period makes it necessary to employ imported labour for both activities. There is a need for a labour allocation programme for rural households, and members of the households should gain skills related to the tourism industry. On the other hand, the solution to the problem of competition for the labour force between agriculture and tourism lies in improving all-year-round, and particularly winter, tourism (emphasising the fact that the region is a tourist resort that can be visited throughout the year through improved publicity), improving "pick-your-own" and organic farming activities, as well as farm visits, attaching importance to handicrafts and deploying the idle unemployed labour force into handicraft production, giving importance to the festivals which may be helpful for publicising the region, and improving and diversifying animal husbandry activities in households.

The reasons why households become oriented towards tourism are varied. In line with projections, it appears that 76.4% of the households have engaged in tourism-oriented activities in order to acquire additional income, while 23.6% are seeking to utilise the

idle unemployed labour force, and to put to use inactive sources to evaluate whether tourism can be a source of livelihood. According to 89.1% of the households, tourism-oriented activities have had a positive impact on their living standards, while 10.9% claim tourism has had a positive impact on neither their living standards nor income. Regarding the affect on income, 42.5% of the households said that tourism had had a positive impact on their economic lives, stating that both their incomes and savings had increased; 39.4% stated that their income, savings, and expenditures had increased, and consequently their welfare level had improved; 16.3% stated that only their income, and thus their level of prosperity, had improved; while 1.8% stated that they had been able to make more investments into tourism. The impact of local tourism varies greatly among rural regions, and depends on a host of factors, including labour force characteristics and seasonality issues. Tourism strategies must be consistent with local development goals (including local support) and should be sensitive to maintaining the community characteristics (Woods, 1992; Bourke and Luloff, 1995).

The advantages of performing both agricultural and tourism activities in the households have also been studied. Of the households surveyed, 56.3% stated that the income gained from tourism contributes to the household income; 18.1% stated that in addition to this contribution they use tourism income as a guarantee against the risks and uncertainties of agricultural activity; and 16.3% stated that they use tourism income only to try to guarantee against the risks and uncertainties that are inherent in agricultural activities. When the households were questioned about the disadvantages of performing both agricultural and tourism activities together, 40.0% stated that it brought about an insufficiency of labour force and time, 32.9% stated that there were no disadvantages, and 7.2% stated that because of economic insufficiencies they neglected their farming activities (such as agricultural spraying, fertilising, and irrigation) in certain periods.

Furthermore, 83.7% of the households stated that they would be inclined to perform both agricultural and tourism activities in the future, while 16.3% stated that they would prefer to engage in only one of the two activities. The survey also ascertained that 66.6% of the households were considering giving up their tourism activities, stating that they had been unable to make a sufficient economic gain from tourism; 22.3% stated that there is no more economic capability to implement and continue tourism activities; and 11.1% stated that tourism activities were as open to risks and uncertainties as their agricultural activities. Of the households which planned to continue their tourism activities, 43.4% stated that their tourism income had almost reached a level at which they could be compared with their income from agriculture; 34.7% stated that they were not affected too much by income loss, which can occur in either of the activities as they perform both agricultural and tourism activities together; and 15.5% stated that they did not consider giving up tourism activities, as they constitute an additional source of income. The remaining participants did not respond to the question.

According to 98.2% of the households, in the districts of Ürgüp and Avanos, environmental (natural and historical) assets are being protected in parallel to tourism activities, while 1.8% of the households hold the view that these values are being destroyed because of the growth in tourism. Destruction of the natural and historical environment, or the

failure to protect these environmental assets, is attributed to the ignorance of both the local people and the tourists. According those surveyed, 89.1% of the entrepreneurs stated that there has been no degradation of historical houses, baths, mosques, and churches, and 76.4% stated the same regarding the species and numbers of game animals, whereas 96.4% said the same of spas, healing waters, and caves. According to the households surveyed there has been no degradation of the natural and historical beauty of the region.

The sites visited by both domestic and foreign tourists have also been examined, and it is noted that there is no discernible difference between foreigners and local people in their choice of places to visit. Of the foreign and domestic tourists, 43.6% visit the region to see the chimney rock formations, 27.2% came to see the churches, 19.6% to see caves, 7.1% to see craft workshops and stores, and 2.5% to see or visit all of the available and appropriate locations. The interesting natural, cultural, agricultural, and historical elements of the region appeal to both local and foreign tourists.

The reasons why foreign tourists visit the districts of Ürgüp and Avanos vary substantially depending on the season and the nationality of the tourists. Of those surveyed, 41.8% of foreign tourists prefer the region of Nevşehir to see the historical and natural attractions and faith tourism; 34.5%, in addition to faith tourism, say they come to see the historical and natural attractions; 7.3% to see handicraft activities on location; and 7.3% to see both historical and natural attractions and handicraft activities on location.

According to 94.6% of the domestic tourists, the districts of Ürgüp and Avanos possess high tourism potential. It was found that 36.4% of the respondents prefer to see wonders of nature; 21.8% the intact natural environment and countryside; 12.7% to see only the intact natural environment; 12.7% to see the intact natural environment along with wonders of nature; 7.3% to see the monuments, galleries and museums; and 9.1% only to see the countryside in the regions where they are able to make excursions.

3.6 The State of Infrastructure and Evaluation of Interests/Tendencies of the Households

The infrastructure network and transport systems make it easy for both domestic and foreign tourists to arrive in the district. Tourists use coaches and village minibuses (47.3%), only village minibuses (23.6%), only coaches (14.5%), private owned vehicles (7.3%) and coaches and privately owned vehicles (7.3%) to arrive in the villages. Of the households surveyed, 45.6% believed the publicity activities inside and outside the district to be insufficient, while 7.2% stated that the insufficiency of capacity, cleanliness, and maintenance of the accommodation and recreation facilities were important factors hindering the development of tourism.

The opening of rural areas in Turkey to tourism activities was believed to be a positive step by 94.6% of the entrepreneurs; but 43.6% of this figure stated that it was necessary to increase efforts to ensure that rural tourism becomes an additional source of income for households; while 9.0% implied that rural tourism could bring about positive contributions to the national economy. Additionally, 47.4% pointed out that there are

both positive and negative sides of the social and cultural changes that may be caused by tourism in rural areas. Tourism not only results in raising employment opportunities, increasing income potential for local residents and diversifying the local economic base for rural areas, but can also increase community visibility and add cultural opportunities or conflicts for residents.

When the households were asked whether tourism has had an impact on the economic improvement (such as improved infrastructure, increase in the number of new work places) of the region, 87.3% of the households gave positive responses, while 12.7% gave negative responses. When the households were asked whether the living standards of people who live in Avanos and Ürgüp are better or not than those in the neighbouring districts which are open to rural tourism, 78.2% of the households stated that they had better living standards, whereas 21.8% stated that there was no discernible difference. According to 79.1% of the households, the advantage of the rural households in the districts of Avanos and Ürgüp in generating income from tourism is that there are more chimney rock formations in these districts; while 20.9% stated that there are more natural attractions in the region as compared to other regions, and that the mentioned districts are highly preferred by tourists.

3.7 Contributions of Tourism to the Utilisation of Labour Force and Local Products

Tourism activities support the productive capacity of households by increasing skills and providing cash for operational capital and investment. The new skills gained by household members involved in tourism can be transferred to other activities (Ashley, 2000). The results represent that the first option is very limited in the rural Cappadocia Region. Of the households surveyed, 29.0% noted that rural tourism reduces migration from the district to other provinces or countries by creating employment. According to 81.3% of the households, the disappearance of the differences between their province and the big cities, the decrease in the attractiveness of the cities, and thus the migration tendencies of well-educated and young people has been decreased. Some 18.7% of the households have asserted that job opportunities had increased, and that therefore external migration was gradually decreasing thanks to tourism, while 71.0% of the households stated that tourism is not developed enough for the total elimination of external migration in the short term, and that at its present level of development could not reduce migration to other provinces or countries.

The opinions about the welfare levels of the labour force working in tourism enterprises and the labour force working in agriculture and other sectors have been examined. Results show that 85.5% of the households suggested that the welfare levels of those working in the tourism sector are higher than of those working in other sectors. The rate of households that considered tourism as an important factor in the reduction of unemployment in the district by creating opportunities for employment is around 80.0% among all the households. The households that think this way relate unemployment with different causes. The survey ascertained that 47.7% of the households attributed the new employment opportunities and the drop in unemployment to the tourism activities in

the region, whereas 27.4% of them felt the cause was with hotels, 15.9% for handicrafts, and 9.0% for tour guide and boarding house employment. Since the educational levels and capabilities of household members are not sufficient for tourism-oriented activities, generally qualified hired labour is employed.

The survey revealed that 69.1% of the households believe rural tourism plays an important role in the perpetuation of handicrafts (such as pottery and carpet manufacture), whereas 30.9% delivered a contrary opinion. All of the houses that believed rural tourism contributes to the development of handicrafts stated that these activities are maintained thanks to tourism. While 51.0% of the households contend that the manufacturers of pottery and other crafts sufficiently benefit from tourism incomes, 49.0% did not believe they drew much benefit from tourism income.

The share of entrepreneurs stating that cultural activities are increasing in parallel to tourism among all the households is 69.1%. The share of the households being of the opinion that tourism resuscitates the local economy is 98.2%. The rate of households that believe the present service quality of markets, shops, restaurants, and hotels is increasing in parallel to the development of tourism is 96.4%, while 92.8% of the households have stated that the local community is becoming more tolerant of people of different cultures as a result of becoming acquainted and spending time with tourists.

According to 74.7% of the households, the organisation of pottery festivals has a positive contribution to tourism, whereas 18.1% believe that these festivals do not affect the development of tourism; 7.2% of the households did not present an opinion on the issue. According to 74.6% of the households, the organisation of such activities as festivals, fairs and harvest days will have a positive effect on the publicity and benefits of the tourism potential.

The positive and/or negative changes in the agriculture sector caused by the development of tourism activities in the rural areas of the districts of Ürgüp and Avanos have been investigated. According to 72.8% of the households, the development in tourism activities has lead to a shrink in agricultural activities, while 27.2% believe the development of tourism has not had the slightest negative effect on the volume and development trend of agricultural activities. It has been found that 85.0% of the households that believe tourism has resulted in a regression in agriculture contended that tourism incomes are becoming more attractive day by day, and 15.0% highlighted that making money from tourism is easier, and that agriculture is in regression. All of the households that stated that agricultural activities do not regress in parallel to the development of tourism also stated that those who consider agriculture as their occupation do not attach much importance to tourism, and that they consider tourism as an activity bringing about additional income. It has been established that the households focusing on tourism activities do not work land by rental or crop-sharing agreements with others, and that they do not include animal husbandry activities within the structure of the enterprise.

3.8 Alternative/Complementary Relationships of Enterprises and Entrepreneur Tendencies

The results of the economic assessment indicate that tourism activities are complementary to agricultural activities in terms of their contributions to the total household income. According to 47.1% of the households, tourism is an alternative to agriculture, whereas for 52.9% tourism-oriented activities are complementary activities for agriculture. All of the entrepreneurs that regarded tourism activities as an alternative for agriculture have related the reason for this as being the reduction in the profit they make from agriculture. Some 85.0% of the households who regard tourism as complementary to agricultural activities have stated that tourism provides additional income to their agricultural activities, whereas 15.0% have stated that they adopt tourism as being complementary to agriculture because of the natural risks that agricultural activity bears (keeping in mind that risks like these are less likely in tourism activities).

The households made positive declarations about the utilisation of tourism incomes in agriculture. The share of the entrepreneurs stating that tourism incomes are supportive of farming among the total entrepreneurs is 80.0%. For 16.4% of the entrepreneurs, tourism incomes mitigate the risk factor involved with agricultural activity; 3.6% presented no opinion about the issue. While 83.7% of the households stated that they directed the income they made from tourism to agriculture, 16.3% stated that this was not necessary, and that they invested their savings into non-agricultural fields. The survey revealed that 54.6% of the entrepreneurs who transfer tourism incomes to agriculture buy seeds, fertilisers, and fuel-oil with these incomes, whereas 30.9% stated that they met the expenses of the labour force, and 14.5% stated that they use tourism incomes to purchase agricultural equipment and machinery. The investment of tourism earnings into agriculture is also preferred in a very limited scope by households. It is obviously stated that the linkage between agriculture and tourism activities in the same rural household should be strengthened by an efficient transfer mechanism of cash flows.

According to 69.1% of the households, tourists visiting the district are interested in agricultural activities, while according to 30.9% of the households visitors with no interest in agriculture and rural areas do not spend much time in these areas. Based on the profiles of the visitors, the high interest in agriculture and the high agricultural potential of the district, it is confirmed that there is a high potential to develop agricultural tourism in the district in the future, and that it is possible to vary tourism-oriented activities in the rural areas. When the entrepreneurs who stated that tourists were interested in agricultural activities were asked about their methods, 47.6% stated that they took tourists around the farm and answered their questions, whereas 11.8% stated that they briefly talked about the crops yielded in the district. Only 7.3% of the households have stated that they made use of the products they cultivate in their enterprises for tourists. All of the entrepreneurs providing accommodation stated that they are keen on consuming the agricultural products they cultivate with tourists. However, it should be noted that only 11 of the households surveyed were providing accommodation. Although it depends greatly on having a family lodging house business to have a chance to make use of the products cultivated within the enterprises, it is possible to sell these products to buyers

by means of roadside sales and other direct marketing methods. In order for tourism activities to be sustainable within the district, the relationships of these activities with agriculture, natural characteristics, and especially handicraft production, have to be strengthened. Direct marketing strategies, such as farm markets, pick-your-own, farm stands, roadside markets, on-farm sales, and entertainment farming should be developed in rural areas.

Of the households surveyed, 72.8% stated that they were not aware of anyone who had completely given up their agricultural activities after beginning tourism activities, whereas 21.8% stated that they were; 5.4% gave no information on this issue. It was also found that 80.0% of the households regarded farm tourism as "tourists touring around rural areas and farms, and at the same time consuming products cultivated in the district," and stated, "It can be quite beneficial to develop agricultural tourism in our country in many regions and provinces." The results clearly show that the tourism potential of the rural Cappadocia Region has not been utilised effectively, and that the participation of the local people in tourism-oriented activities is very limited.

4 Conclusion

Tourism activities in rural areas should be developed through the setting of rural policy programmes in Turkey, which will maximise the benefits locally, and minimise the impacts of social problems. The Cappadocia Region examined in this study has significantly high tourism potential thanks to its natural and historical structure and its agricultural and rural characteristics. The high tourism potential in the region has varying effects on households, whose main source of income comes from agriculture. The households provide 73.5% of their total annual income from agricultural activities and 26.0% from tourism related activities, which is the second most important source of income. Tourism oriented activities include pottery, handicrafts, and provision of accommodation, from which pottery brings the highest source of income, accounting for 55.1%. It is clearly stated that the tourism potential of the rural areas has not been utilised and the participation of the rural population in tourism-oriented activities has been very restricted due to the limited working capital, among other socio-economic factors.

Although the households have sufficient economically active residents (accounting for 74% of the population), there are some shortcomings in terms of labour that can be transferred into tourism activities. These shortcomings can be divided into two groups; namely shortages of qualified employees and insufficient labour force. The education levels and personal abilities of the majority of the household populations are quite low for the maintenance and development of tourism activities. Nearly all of the households can be classed as small family enterprises in terms of operating farmland, and 33.1% of the labour force remains idle. Although it may be seen to be a rational solution to absorb the idle labour force into tourism activities, the low quality of the labour force and the demand for labour in tourism and agricultural activities in the same periods emerges as a serious handicap.

A similar problem is encountered in the working capital demands of both activities. The total assets of the households and their distribution among the resources show that the household working capitals are insufficient. In addition, the agriculture and tourism sectors need working capital in the same periods, and this leads to competition between the two sectors. The cash turnover of animal husbandry activities is faster when compared with crop production activities, and thus the two activities traditionally compensate for each other within in a business. When tourism activities are included, the problem is exacerbated. The rational solution at this point is to compensate agricultural activities with tourism activities, which are bring in cash income faster and have a higher turnover than agriculture, and then distributing the surplus from agricultural activities between the two activities in the most optimum way. However, here emerges the question as to whether there is a surplus from the annual household income, and whether families obtain sufficient farm and total incomes. Although it has been determined that the households have adequate incomes, because the two activities are seasonally competitive for working capital it becomes impossible to bring about a solution to this problem.

The results have shown that tourism and agricultural activities within the households are competing in terms of demands on labour force and working capital. In this regard, it is vital to take measures to transform these two activities from being competitive to being complementary. In order to reduce the competition between agriculture and tourism activities there is a requirement to enliven handicrafts, animal husbandry activities, organic farming, and winter tourism, as well as the participation rate of rural households in these activities in the region. It is necessary to give priority to activities which may attract tourists, such as organic farming, organic food production (particularly organic vine) and equestrian husbandry, and integrate tourism and agriculture, handicrafts, and natural beauties with each other completely. The domestic and foreign tourists that were interviewed have stated that their primary reasons for visiting the region include the natural and historical characteristics of the region, as well as handicrafts and the geographical position of the region. To develop tourism in the region, other attractive/leisure related functions provided by agriculture and rural areas will need to be added to these factors.

As tourism revenues become more attractive day by day for the young and relatively higher educated population in the rural regions, as it is easier to earn money through tourism than agriculture, and because tourism activities are more attractive, agricultural activities may gradually begin to be considered as being of secondary importance. However, it should be remembered that in addition to natural and historical values, agriculture, and handicrafts have an important role to play in the improvement of tourism activities in and around Nevşehir, and in addition to other branches, priority should be given to rural tourism. It is possible that organic farming, viniculture, and particularly organic wine production may become the leading forces in improving rural tourism. Instead of single-source based tourism, this will enable the diversification of tourism sources and the slowing of the destruction process of the natural resources in parallel to the improvement in tourism activities. Tourism can diversify the livelihoods of rural households, minimise risks and uncertainties in agriculture, maintain liquidity in households and increase employment rates, thus decreasing the uncontrolled migration

from rural to urban areas or abroad. In order to ensure an improvement in income and living standards in rural areas and to accelerate a structural transformation in Turkey, households should be encouraged to engage in both agricultural and non-agricultural activities, and generate income from these activities, as is the case in other developing countries.

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ПЕРВЫЕ ЭТАПЫ ОНТОГЕНЕЗА И РИТМ РАЗВИТИЯ *Wistaria floribunda* (Willd.) DC. В ЦЕНТРАЛЬНОМ ТАТЖИКИСТАНЕ

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Одной из основных задач интродукции растений является введение новых наиболее перспективных видов в широкую культуру, а для наиболее успешного выполнения этой задачи необходимо иметь представление по основным фенологическим фазам, т.е. выявить наиболее декоративные фазы. Кроме этого успехом интродукции должно быть глубокое изучение биологии их индивидуального развития (онтогеноза) в целом и его отдельных этапов в частности: латентный период, этап проростков, ювенильных растений и т.д.

Изучению онтогенеза цветковых растений посвящено несколько научных исследований проводившихся, например, Московским педагогическим институтом, Уральским университетом и другими научными школами, как бывшего союза, так и за рубежом. В этих работах мы можем выделить два основных направления онтогенетических исследований: первое это эволюционно-морфологическое (Серебряков, 1952; Гатцук, 1967; Шафранова, 1967 и др.) представляет собой опыт использования морфологических закономерностей в прцессе формирования особи для выяснения путей морфологической эволюции в пределах конкретных филогенетических рядов. Второе направление называется популяционно-онтогенетическое, в задачу которого входит выяснение морфологических особенностей последовательно сменяющих друг друга в индивидуальном развитии растений, вплоть во завершения онтогенеза, с целью выяснения возрастного состава видовой популяции по схеме Т.А.Работнова (1950) (Уранов, 1967 и др.).

В целом, онтогенез цветковых растений понимается в данном случае как последовательность сменяющих друг друга морфологических состояний и изменений растений от прорастания семени до отмирания особи и в случае вегетативного размножения-всего вегетативно возникшего потомства.

1 Материал и методика

Среди деревьев и кустарников интродуцированных в Центральный ботанический сад АН Республики Татжикистан (ЦБС) большой интерес для декоративного са-

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доводства и озеленения представляет такая жизненная форма как лианы. Одним из наиболее перспективных видов в условиях Татжикистана является Wistaria floribunda (Willd.)DC., относящаяся к семейству FabaceaeLindl.

В ЦБС этот вид был завезён из Батумского ботанического сада в 1934 году.

W. floribunda. Родина – Япония. Листопадная древовидная лиана, поднимающаяся по опоре до высоты 8 (13) м. Листья крупные 30(40) см длины, непарноперистые. Цветки до 1,5 см в диаметре, голубовато-фиолетовые, собраные в повисающие кисти до 50 см длины.

Для наблюдений были отобраны 3 модельных растений. Схемы возрастных состоянийбыли заимствованы из работ Т.А.Работнова(1950) и И.Г.Серебрякова (1952).

Определение лабораторной всхожести семян 1000 шт., размеров семян проводили по методике Бейдеман И.Н. (1974).

2 Результаты исследования

Первые этапы онтогенеза *W. floribunda* можно разделить на три периода латентный, виргинильный и ювенильный. Рассмотрим подроюно каждый из этих периодов и дадим им морфологическую характеристику.

Латентный период протекает в плодах – бобах. Бобы до 15 см длины, удлинённые, слегка перетянутые, плоские, бархатисто опушённые, раскрывающиеся. Семена *W. floribunda* имеют монетообразную форму, диаметр семян составляет примерно 1.66 см, а высота 0,4–0,6 см. Снаружи семя покрыто очень плотной тёмно-коричневой, почти чёрной, блестящей семенной кожурой. Внутри находятся две семядоли окрашенные в беловато-бежевый цвет. Между ними расположена почечка, зародышевый корешок и гипокотиль.

Созревание семян происходит в октябре месяце в это время их рекомендуют собирать. Вес одного семени составляет от 0,60 до 0,95 гр, а вес 1000 штук соответственно равен 600–950 гр. Высевают семена в феврале-марте, перед поневом лучше всего их стратифицировать или обдать горячей водой 70-80°С. Всходы предварительно обработанных семян появляются на 7-10 день. Всхожесть семян составляет 50–70 %.

Прорастание у *W. floribunda* подземное, при этом гипокотиль недоразвивается, и семядоли, обычно забитые питательными веществами, остаются под землёй (Серебряков, 1952; Бейдеман, 1974). По исследованиям И.Т.Васильченко (1945), Подземное прорастание является древним признаком. Посев семян производили в начале февраля.

Виргинильный период. Пррастание у *W. floribunda* отмечается в конце первой декады февраля с появлением корешка длиной 1,5 см. На следующий день на поверхности почвы отмечено появление бесцветной верхушечной почки, но после попадания солнечных лучей почка начинает окрашиваться в зелёный цвет. В середине феврыля длина корешка уже составляет 1,9–2,5 см, а проростка — 2,5–3,0 см, он весь покрыт недиференцированными низовыми, чешуйчатыми, листьями, заложившимися ещё в зародыше, выше по проростку расположены низовые ли-

стья с недоразвитой пластинкой, формирующиеся при прорастании. На верхушке проростка формируются зелёные листья, которые к середине февраля начинают отделяться от главного стебля, при этом длина листа составляет 3,5 см. А черешка — 2,1 см. Первый лист сложный непарноперистый, количество листочков составляет 5(7) штук, т.е. 2 (3) пары и один на верхушке рахиса. Листочки все сомкнуты, ещё не развёрнуты и плотно прижаты к чекешку листа по направлению к верхушке. Полное развёртывание первого настоящего листа отмечено в конце второй декады февраля, т.е. на 5-й день (рис. 1).

Рис. 1: Морфологические особенности проростков *W. floribunda*

1. Прорастание семени (11.02.),
2. Вытягивание гипокотиля (12.02.),
3. Начало формирования листьев (19.02.),
4. Формирование 1 и 2 листа (23.02.),
5. Проросток (25.05.) 30-45 см

Второй лист появился в начале третей декады февраля. Первые два листа нежно-зелёные, а в месте прикркпления к стеблю имеют утолщения крастоватого цвета, а при основании черешка-рахиса есть бледно-зелёные прилистники. Листорасположение на проростнике очерёдное.

В третьей декаде февраля отмечено начало формирования 3-го листа. Количество пар на 1-м листе — 2(3), на 2-м — 3 пары, а начиная с 7-го листа уже 4 пары листочков. 6-й лист появляется ровно через 1 месяц после начала формирования 3-го листа, т.е. в третьей декаде марта. С появлением 7-го листа, в начале апреля, высота проростка составляет 10 см, а длина корневой системы равнялась 15 см.

Хотелось бы отметить, что при травме верхушечной почки, её гижели или усыхании в связи с неблагоприятными климатическими условиями (15.04) на проростке интенсивно начинает развиваться боковая почка, при этом сразу формируются 2 листа (1.05), которые быстро растут и очень скоро по размерам сравниваются

с первыми настоящими листьями. Высота растения на 25.05 составила 12 см, а длина корней системы — 17 см.

Если рассматривать *первые этапы онтогенеза* у *W. floribunda* по Т.А Работнову (1950), то можно отметить следующее, виргинильный период или девственный, продолжается от 3-х до 5-6 лет, затем растение вступает в генеративную стадию. Виргинильный период подразделяется на период всходов, юношеский (ювенильный) период и переходный (имматурный или прематурный) период и период взрослого растения, неспособного ещё цвести и плодоносить.

Всходы, или проростки, у *W. floribunda*, этот период длится около 10-12 дней, это период когда проросток наряду с самомтоятельным питанием, при помощи корневой системы, питается используя питательные вещества материнского растения заключённые в семени.

Ювенильные растения, в отличие от проростков, вполне самостоятельные, когда автотрофное питание осуществляется посредством своих первых настоящих листьев и системы главного и придаточных корней. Этот период длится 2-3 года, растение растёт довольно медленно и выглядит немного угнетённо. Активный рост наступает на 3-ий год жизни, при этом длина побега за один вегетационный период достигает1,2-1,8 (2,0) м, растение имеет хорошо сформировавшуюся корневую систему, внешний габитус растения приобретает признаки взрослого растения.

В 5-6 лет наступает генеративный период, который продолжается до конца жизни растения. В этот период растение интенсивно растёт, цветёт и плодоносит, что является самым декоративным периодом *W. floribunda* и именно этот период является наиболее важным для оценки успешности интродукции.

Краткие сведения по **фенологии** *W. floribunda* в условиях Центрального Татжикистана приводят А.С.Королева (1962), М.И.Исмаилов (1965), В.В.Вилисова (1986) и др.

Мы проводили наблюдения за сезонным ритмом развития *W. floribunda* как в условиях ЦБС, так и в условиях промышленного загрязнения (ТЭЦ) и в парке им.С.Айни (район цементного завода) с 2002 по 2004 года. Как показали наши наблюдения, на сезонный ритм развития большое влияние оказывают не только климатические условия, но и местопроизростание исследуемого вида. Годы наблюдения характеризовались различными погодными условиями. Весна 2002 года (7-11 марта) в г.Душанбе отмечена сильным снегопадом с кратковременным понижением температуры до -10 °С. Зима 2002-2003 гг. Была относительно устойчивой, но в феврале месяце было отмечено понижение температуры до –19 °С. Средняя годовая температура +14,2 °С. Абсолютный минимум температуры –29 °С, а максимум +43–44 °С. Годовое количество осадков в среднем 500–600 мм. Максимум осадков отмечен в зимне-весенний период. Относительная влажность воздуха 50-70 %, максимальная – в марте, минимальная – в июле. Вегетационный период 210-230 дней, характеризуется обилием тепла и света.

W. floribunda начинает вегетировать при среднесуточной положительной температуре воздуха 13 °С и не провоцируется кратковременными потеплениями в зимне-

весенний период. Неблагоприятные погодные условия весны 2002 года – понижение температуры в марте и снегопад – значительно задержали начало вегетации в ЦБС (таблица), по сравнению с 2003-2004 годами как в условиях ТЭЦ, так и в парке им.С.Айни.

Таблица 1: Фенология *W. floribunda*

Место	*Годы*	*Начало развер. почек*	*Начало облист вления*	*Цветение*		*Созрев. Плодов*		*Листопад*	
				Начало	*Конец*	*Начало*	*Полно*	*Начало*	*Массов*
ЦБС	2002	15.04	23.04	13.04	19.05	21.10	15.11	10.11	20.11
	2003	5.04	12.04	20.03	23.04	15.10	20.11	20.11	25.11
	2004	8.04	15.04	22.03	26.04	16.10	22.11	20.11	27.11
ТЭЦ	2002	10.04	21.04	10.04	12.05	20.10	14.11	10.11	22.11
	2003	4.04	10.04	20.03	22.04	14.10	18.11	15.11	24.11
	2004	5.04	12.04	19.03	12.04	12.10	19.11	21.11	28.11
Парк	2002	15.04	24.04	15.04	21.05	20.10	16.11	10.11	21.11
им.С.	2003	6.04	12.04	22.03	27.04	15.10	19.11	21.11	24.11
Айни	2004	8.04	16.04	20.03	24.04	16.10	20.11	20.11	25.11

Как видно из таблицы, можно отметить, что в парке им.С.Айни и ЦБС начало и окончание фенологических фаз сдвинуты на 3-5 дней на более поздние сроки.

За годы наблюдения у *W. floribunda* отмечены повреждения годичных побегов низкой температурой (–19 °C) в зимний период. Это подтверждает, что *W. floribunda* теплолюбивое (субтропическое) растение.

В обычные, не холодные зимы, начало развёртывания почек приходится на первую декаду апреля – середину апреля. В этот период наступает интенсивный рост побегов, который продолжается до наступления осенних заморозков. Цветение начинается почти одновременно, или немного раньше, с распусканием листьев. Первое цветение продолжается в течение 30-35 дней, а второе цветение – во второй декаде июня и продолжается до конца июля.

Phases of the phenological of *Wistaria floribunda*

G. N. Ergaschewa and W. Drauschke

Abstract

Phases of the phenological of *Wistaria floribunda* (Willd.) DC are shown to disclose the perspective dates of the vegetation embracing the phases of flowering (March-April), of ripening of the fruits (October) and of having complete foliage (April-October). The first course of development or ontogeny, the germination, covers a period of 10 – 12 days; the growing phase embraces a period 2 – 3 years and development to maturity from 3 to 5 or 6 years, before the generative phase begins. A huge quantity of seeds is required in the fields in comparison to the cultivation in botanical gardens, where only 50 – 70 % of this demand is needed.

Keywords: environmental pollution, environmental demages, lianas, climbers, Middle Asia, Dushanbe, climatic data, botanical investigations

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ISBN 978-3-89502-238-8. Brosch, Preis: (D) € 14,80, (A) € 15,40, sFr. 26,80.

Die Autorin untersucht und beschreibt ungewöhnlich detailliert die überlieferte Kulturtradition, welche die einst so mächtigen Tuareg geprägt hat. Die Regeln und Verhaltensnormen sind an den Status gebunden und schränken die Freiheit des Individuums erheblich ein. Sie verleihen ihm aber auch, wenn konsequent befolgt, Ansehen und Einfluss. Insgesamt wirkt das gesellschaftliche Regelwerk stärkend auf die Gemeinschaft. So ist das gesamte Wertesystem wesentliche Begründung für die frühere Macht dieses Volkes, sowie die Grundlage der nomadischen Lebensweise und für die Fähigkeit in einer grundsätzlich feindlichen Umwelt zu überleben. Obwohl der Tuareg-Gesellschaft infolge der französischen Kolonialkriege und nicht zuletzt durch die unabhängigen Staaten der Zusammenhalt und die wirtschaftliche Basis genommen wurde, haben viele Elemente der Kulturtradition die Umbrüche überdauert. Andere, wie beispielsweise Ehrenkrieg und Ehrenraub, sind verfremdet und können allenfalls Phänomene wie aggressives Betteln und Raubüberfälle erklären.

Das Buch gliedert sich in zwölf Texte, die jeweils eigene Themen behandeln. Sie reichen von der Bedeutung des Gesichtsschleiers über die Rolle der Frau bis zu den Gesetzmäßigkeiten des Nomadismus. Das überlieferte Wertesystem und die Probleme in der postkolonialen Zeit sind ein wesendlicher Bestandteil der Betrachtung. Das vorgelegte Buch legt Zeugnis ab von der intimen Kenntnis der Autorin von der Kulturtradition, der Sozialstruktur, sowie von Sprache und Schrift dieses Wüstenvolkes.

Eckhard Baum, Witzenhausen

Veterinaria Italiana 43(3) 2007: Special Issue "Geographic information systems"

Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise 'G. Caporale' in Teramo, Italy, ISBN 88-9017-256-8, 406 pages, € 50,00

Recent years have seen several severe outbreaks of animal diseases, such as BSE, Foot and Mouth Disease and Avian Influenza, some of which are serious threats to humans, in various parts of the world. The necessity to detect such outbreaks in a timely manner, to predict their spread and to quickly and effectively respond to incipient epidemics has

highlighted the importance of including a spatial component into studies dealing with veterinary and public health.

This special issue of Veterinaria Italiana provides a comprehensive overview of recent developments in this field over the past few years. It consists of 43 peer-reviewed articles presenting studies that incorporate the use of Geographic Information Systems (GIS) into veterinary medicine. These studies, which had originally been submitted for an international conference on the use of GIS in veterinary activities, are grouped into five separate sections covering (1) the importance of GIS for the monitoring of animal diseases and zoonoses, (2) GIS applications in surveillance activities, (3) spatial analysis in veterinary epidemiology, (4) data collection and remote sensing applications, and (5) web-GIS as tool for data and knowledge sharing. This monograph thus covers all fields of veterinary epidemiology, from monitoring of disease vector populations and livestock herds, to predicting disease outbreaks and disseminating information about such outbreaks to scientists, decision-makers and the public.

With few exceptions, the research presented in this issue appears of high quality and relevance to pressing issues of veterinary and public health. The overall appearance of this book is professional, including a visually attractive layout and the articles are presented in mostly flawless English, even though authors of a wide range of nationalities contributed. In spite of the editors' apparent efforts to improve submitted images by editing most text in the illustrations, some maps are of rather low quality.

Overall, this work provides an excellent overview of the state of the art of GIS in veterinary activities and is highly recommended for everyone involved in this field.

Eike Luedeling, Witzenhausen

Notes to authors

The Journal of Agriculture in the Tropics and Subtropics publishes papers and short communications dealing with original research in the fields of rural economy and farm management, plant production, soil science, animal nutrition and animal husbandry, veterinary hygiene and protection against epidemics, forestry and forest economy.
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