

PROCEEDINGS OF JAFFNA SCIENCE ASSOCIATION

ABSTRACTS 1999



Seventh Annual Sessions

07 - 09 April 1999

JAFFNA

SRI LANKA

1999

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JAFFNA SCIENCE ASSOCIATION**

ABSTRACTS - 1999



**SEVENTH ANNUAL
SESSIONS**

07 - 09 APRIL 1999

JAFFNA,

SRI LANKA

1999

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This volume is a record of the Proceedings of the Seventh Session of the Jaffna Science Association. This contains the abstracts of papers accepted for presentation at the Seventh annual Session of the Jaffna Science Association to be held at University of Jaffna from 8 - 10 April, 1999. It contains four (03) abstracts in Pure Science (Section A), thirty six (36) abstracts in Applied Science (Section B) and one (01) abstract in Medical Science (Section C).

I wish to thank the Chairmen of all sections for their assistance in getting these abstracts refereed in time for presentation at this Annual Session.

Prof. (Miss) V. Arasaratnam
Editor of the Proceedings
March 14, 1999



This volume is a record of the proceedings of the Scientific Section of the Indian Science Association. This contains the abstracts of papers presented for presentation at the 26th annual session of the Indian Science Association to be held at University of Jodhpur from 8 - 19 April, 1959. It contains four (4) sections in four sections (Section A), thirty six (36) abstracts in Applied Science (Section B) and one (01) abstract in Medical Science (Section C).

I wish to thank the Chairman of all sections for their assistance in getting these abstracts together in time for presentation at this annual session.

Prof. (Mrs) K. Aravamudan
Editor of the Proceedings
March 14, 1959

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FEEDS AND FEEDING OF *GERRES OBLONGUS* DWELLING IN THE JAFFNA LAGOON

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Gerres oblongus is a highly consumer demanded and economically important fish species found in the coastal areas of the Jaffna lagoon. Stomach contents of 179 specimens of *Gerres oblongus* ranging in standard length from 4.0 to 30.9 cm collected from five locations along the Northern coast were examined during the period November 1996 to October 1998. The food analysis was carried out by two quantitative methods, viz., the numerical abundance method and the occurrence method. Analysis of gut contents of *Gerres oblongus* indicated that *Gerres oblongus* is omnivorous, feeding on different genera of diatoms, blue - green algae (*Calothrix*), macrophytes (*Thalassia*), sponges, insect larvae, molluscs, small fishes and polychaetes (*Nereis*). On numerical basis, molluscs form 44.45% of the feed while crustaceans form 27.13%. By the occurrence method, molluscs occurred in 78.12% of stomach and crustaceans occurred in 56.4% of stomachs. The smaller fish of *Gerres oblongus* feed largely on phytoplankton and zooplankton. As they grow, their diet become more varied and other forms such as polychaetes, molluscs, higher crustaceans (*Gammarus*, *Paeneus* spp) and insect larvae become important. The insect larvae observed in the present investigation was a freshwater species which would have been entered the sea along with the flood waters. The composition of food items varied throughout the investigation period. The mean relative gut length of *Gerres oblongus* showed a positive increase with the body length. The degree of satiation index was determined and it varied from 1.9 to 4.5. The maximum satiation index of 4.5 and 4.4 were observed in December 1996 and January 1997 respectively. The relationship between the mean relative gut length and the body length showed that there is an overall increase in the mean relative gut length with body length.

DETERMINATION OF PROTEIN EFFICIENCY RATIO OF SOY PRODUCTS

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Protein Efficiency Ratio (PER) is used as an index of protein quality. It is defined as the weight gain of a growing animal (rat) divided by its protein intake, and when conducted under standardized conditions, it is capable of yielding fairly accurate and reproducible results. The soybean and soybean products may exhibit considerable variation in PER values depending on processing conditions. Weaned sprague - Dawley rats were used in this experiment. Two groups of rats were used each containing 11 rats. Control diet (i.e. Prima Fed : Wheat flour: 1:5) was provided to one group. Treatment diet (i.e. Prima feed : Defatted soy flour: Wheat Flour : 1:1:28) was provided to the other group. The diet was prepared in such a way that the total protein contents in both diets were equal (13.3%). The body weight of each rat on the first day of assay period and body weight and food intake of each rat at regular intervals, not >7 days and on 28th day after beginning were recorded. The average 28 day weight gain and protein intake for each group were calculated. In this experiment the PER was calculated for defatted soy flour which is the major raw material for most of the soy products. The PER of control diet was 1.33 and treatment diet (soy diet) was 2.04. The addition of soy flour improved the PER indicating that the growth was improved by the inclusion of soy protein. Much of the knowledge concerning the nutritional properties of the soybean has been derived from experiments with animals, and such knowledge is frequently directly applicable to human nutrition.

LARVICIDAL ACTIVITY OF AQUEOUS NEEM SEED EXTRACT ON THE LARVAE OF *Aedes Aegypti*

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Aedes aegypti is a medically important insect species which transmits virus borne diseases such as Dengue and Yellow fever. The best way to control these diseases is to control the vector mosquito. It was reported that mosquitoes have developed resistance to synthetic insecticides (Rathore *et. al.*, 1986). This study was undertaken to evaluate a botanical pesticide namely the neem seed extract to be used as larvicide for this mosquito species. The mosquito was made to lay eggs in tap water of a glass jar into which added leaf litter. After six days of egg laying, larvae of fourth instar stage were taken for experiments. Neem seed extract of 10 and 20% (M/V) was prepared by grinding the seeds and dipping the powder in water for ten hours. In each of the four wide mouth bottles (300 ml) 50 ml of tap water, 40 ml of larval culture aquatic medium and 10 ml of 1.0% bread dust water (water containing bread dust) were taken. Ten individuals of fourth instar larvae were introduced into each set up. Then 1.0, 2.5 and 5.0 ml of 10% of neem seed extract was added to each of the three wide mouth bottles and fourth was kept as control. Mouth of each bottle was covered by muslin cloth. Like wise 1.0, 2.5 and 5.0 ml of 20% of neem seed extract was introduced to another set of three bottles and fourth was kept as control. In all set up the dead larvae were recorded and removed from the experimental set up in every 24, 48 and 72h. Then the percentage of larval mortality was calculated. When the larvae exposed for 24h at 10% concentration of 1.0, 2.5 and 5.0 ml there was no significant difference in larval mortality between the treatments ($P < 0.05$), whereas when larvae were exposed for 48 and 72h there was a significant difference in larval mortality between the treatments ($P > 0.05$). When the larvae were exposed for 24h at 20% concentration of 1.0, 2.5 and 5.0 ml, there was a significant difference in larval mortality between the treatment ($P > 0.05$). This was true even during exposure for 48 and 72h. It was found that 5.0 ml of 10 or 20% of neem seed extract caused deformity and mortality of 50% of larvae at 72 or 24h respectively. It is concluded that the laboratory study shows that neem kernel extract in small quantity of 5.0 ml of 10 or 20% is lethal to *A. aegypti* larvae when exposed to 72 or 24 h respectively.

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**DETERMINATION OF NYMPHAL STAGES OF
BLACK PEPPER LACE BUG, *DICONOCORIS DISTANTI* DRAKE
(HEMIPTERA : TINGIDAE) BY MORPHOMETRIC STUDIES**

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The objective of the study was to define the number of instars of the black pepper lace bug, *Diconocoris distanti* Drake using morphometric measurements. Lace bugs were reared in insect cages and the samples of nymphs were collected from the cages daily, then killed and preserved for the studies. The greatest width across the compound eyes, width of the head capsule just below the compound eyes and the length of antennae were made to a total of 539 nymphs using an ocular micro meter to find out their measurements in the different instars of *D. distanti*. Frequency distribution of the measurements of all three landmarks gave five clearly separated unimodal groups. Dyar's law was applied to confirm the inference. Mean values of head capsule width across the compound eyes were 0.245 ± 0.05 , 0.32 ± 0.005 , 0.408 ± 0.05 , 0.506 ± 0.005 and 0.622 ± 0.005 mm, head capsule width just below compound eyes were 0.204 ± 0.005 , 0.272 ± 0.04 , 0.335 ± 0.005 , 0.401 ± 0.005 and 0.479 ± 0.004 mm and length of antennae were 0.852 ± 0.006 , 1.08 ± 0.007 , 1.4 ± 0.007 , 1.819 ± 0.007 and 2.644 ± 0.008 mm for the 1st, 2nd, 3rd, 4th and 5th nymphal instars respectively. The regression coefficient (r^2) values for width across the compound eyes, just below the compound eyes and the length of antennae were 0.997, 0.982 and 0.991 respectively. Hence it was concluded that *D. distanti* pass through five nymphal instars and the linear measurements of three landmarks used in this study can be employed in the determination of nymphal instars with high degree of accuracy of other similar species.

**A STUDY OF FLOWER SPIKE DAMAGE ON
BLACK PEPPER (*PIPER NIGRUM* L.)
CAUSED BY *DICONOCORIS DISTANTI* DRAKE**

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Nymphs and adults of the lace bug *Diconocoris distanti* drake were collected from the flower spikes of black pepper (*Piper nigrum* L.) in Sri Lanka during 1995. Since no records available to understand the nature and extent of the damage caused by *D. distanti*, the study was made to assess the flower spike damage in fields in black pepper vines of 4m height from Matale, Kegalle and Kandy districts of Sri Lanka. Each vine was divided vertically into three tiers according to Rothschild (1968). Randomly selected ten flower spikes were assessed from each tier at mid-flowering period in two flowering seasons; November - January 1996/97 and May - July 1997 using a scale introduced by Gumbek (1984). The scale used was 0, No damage; 1 = 5%, Light damage; 2 = 10%, Moderate damage; 3 = 10 - 15%, Quite severe damage; 4 = 15 - 30%, Severe damage and 5 = 30 - 50%, Very severe damage. A total of 30 plants were assessed from a field of 2 ac extent. The mean percent of flower spike damages computed in Kandy, Matale and Kegalle districts were 21, 26 and 27% respectively during November - January 1996/97 whereas 2, 1 and 1% respectively during May - July 1997. The damage was severe in all three places during November - January, during which period flowering was very high. The damage on the flower spikes was higher at middle region than bottom and top regions of the vine. It appears that *D. distanti* is becoming a pest on black pepper vine in the places selected for this studies.

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1. Gumbek, M. (1984). Sampling methods for assessing pepper flower spike damage caused by Tingid bug, *Diconocoris hewetti* Dist., *Annual Report of the Research Branch*, Department of Agriculture, Malaysia, pp. 73 - 74.
2. Rothschild, G. H. L (1968) Notes on *Diconocoris hewetti* (Dist.) (Hemiptera : Tingidae), A pest of pepper in Sarawak (Malaysian Borneo), *Bull. Entomol. Res.*, 58(1): 107 - 118.

STUDIES ON IDENTIFICATION, BIOLOGY AND CONTROL MEASURES OF GRASSHOPPERS ON ORNAMENTAL PALMS

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Grasshoppers cause serious damage to ornamental palms. A study was carried out on the identification, biology and control measures of grasshoppers at the Green Farm Ltd., Marawilla situated in low country intermediate zone of Sri Lanka. Grasshoppers were collected by sweep net and were identified with the help of taxonomic keys and reference collection was made at Horticultural Research Institute, Gannoruwa. Collected grasshoppers were reared in the cages and the biology was observed. Insecticides such as carbaryl 85 WP, diazinon 50 EC, B. P. M. C. 50 EC, fenamiphos 5% GR and benfuracarb 3% w/w were tested for the control of grasshopper. The control of grasshoppers by predators such as mynah bird and praying mantids and by entomopathogenic *Aspergillus* were studied. Studies showed that the species of grasshoppers such as *Atractomorpha psittacina*, *A. cranulata*, *Euprepocnemis alacris*, *Orthacris filiformis*, *Heteropternis respondens*, *Gastrimargus africa*, *Oedaleus abruptus*, *Cyrtacanthacris tatarica* and *Oxya japonica* were associated with palms. Additionally *Neoconocephalus*, *Acrida*, *Hieroglyphus* and *Catantops* were identified as pests of palm up to genus level. The grasshopper, *Euprepocnemis alacris* was identified as a severe pest on *Livistona rotundifolia*. Eggs of *E. alacris* hatched one month after oviposition. Each instar took about 15 - 20 days and total period of development from egg to adult was 115 days. Plants treated with benfuracarb 3% w/w and fenamiphos 5% GR showed less damage when compared to other insecticides. When the aqueous solution of the spores of entomopathogenic *Aspergillus* was sprayed, the mortality of grasshoppers was increased.

IDENTIFICATION OF IXORA PLANTS BASED ON VEGETATIVE AND FLORAL MORPHOLOGY

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A study on vegetative and floral morphology of ixora collected from Sri Lanka, Denmark and Florida (USA) was carried out at green Farm Ltd., Marawila during the period of January - June 1997 to conduct the crop improvement programme. The objective of the study was to prepare a key to identify different varieties and characterize the accessions based on morphological characters. Variation among them was made using morphological characters particularly in stem, leaf and flowers. Among the forty two characters studied, morphological characters with significant differences were observed only in ten characters namely internode length, petiole length, cluster diameter, leaf length / width ratio, petal length / breath ratio, leaf area, petal area / leaf area ratio, corolla tube length, number of flowers / inflorescence ratio and length of the style. Ixora collection has been grouped according to their phenotypic characters. Initially two categories were identified as ornamental and wild types. The ornamental plant types were grouped according to the plant growth habit and plant height. By using above indicated ten characters, sub groups were formed to identify phenotypically close individuals. In this study it was found that one genotype had attractive bright coloured flowers and comparatively large sized petals. The size, shape and arrangement of leaves and petiole of this ixora genotype too had marked differences from other accessions. Therefore this genotype of ixora has significant attractive and economical value.

INFLUENCE OF SALTTERN ON THE SOLUBLE SALTS OF CHEMMANI SOUTHERN PADDY FIELDS

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Soil physical and chemical analysis was carried out to study the effect of saltern bund on the physical and chemical properties of paddy soil at Chemmani. In this studies the concentration of ions such as Ca^{2+} , Mg^{2+} , Na^+ and Cl^- in the soil at Chemmani paddy field area were measured. The results revealed that the salt effect decreased, when going away from the saltern bund into the paddy cultivation area. The measurement of electrical conductivity too gave a similar result. On the other hand the content of soil organic matter was low near the saltern bund but this content gradually increased when going into the cultivation area. The measurement of cation exchange capacity too gave a similar result where as the bulk density of the soil gradually decreased, when going into the cultivation area. The measurements of physical and chemical properties at two depths of soils viz. 22.5 cm (plough depth) and 45 cm at Chemmani area showed that the soil at plough depth had increased organic matter, available nitrogen, K^+ , Po_4^{3-} , cation exchange capacity and low bulk density when going away from the saltern bund. These findings were positively correlated with the productivity of paddy from this area.

COLD STORAGE CHARACTERS OF JUMBO KIVES

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Influence of cold storage on sensory characters and microbial analysis of Jumbo Kives was carried out. Jumbo Kives is a newly formulated formed meat product mainly composed of chicken minced meat, sandwiching garlic butter cream containing cereal binders, isolated soya protein, mixed spices and seasonings. Jumbo Kives were kept at freezing temperature (-18°C) for 8 weeks and random samples were collected biweekly for quality assessment tests. It was found that cold storage did not show significant differences as far as the following sensory characters are concerned: appearance, colour, juiciness, taste, texture and general acceptability. When the samples were analysed for microbes, the total plate count (4.9×10^3) per gram of food was less than 5.0×10^4 . Total coliform count (2.41×10^2) and the total yeast and mould count (6.5×10^1) per gram of food were less than their critical value (1.0×10^3). Test for the occurrence of *Salmonella* and *Staphylococcus aureus* gave negative results to all samples. But although *E. coli* test gave positive answer, the count is below the critical level (1.0×10^1 per gram food). Therefore stored samples are not harmful for human consumption as stipulated by Sri Lankan Standard Institute (SLSI).

**RATE OF FLOW OF SAP WHEN TAPPING
PALMYRAH INFLORESCENCE SAP BY
'KAIVEDDY' TECHNIQUE**

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Both male and female palmyrah palms are being tapped for inflorescence sap. Female palmyrah palms are tapped for inflorescence sap by 'thattu' and 'kaiveddy' techniques. 'Kaiveddy' technique utilizes the inflorescence at 'nungu' stage when the endosperm is sweet and watery. This stage is reached during the months of June, July, August and September, since flowering is seasonal in palmyrah palms. Palmyrah palms were tapped for inflorescence sap by 'kaiveddy' technique at Kokuvil, Jaffna. A palm by 'kaiveddy' technique yielded up to 11 liters of inflorescence sap a day but the average yield of the palm was 8.25 liters day⁻¹, whereas a low yielding palm gave an average yield of 1.08 liters day⁻¹. An average yield of 6 palms is 2.65 liters palm⁻¹ day⁻¹. The duration of tapping a palm varies from 20 - 40 days in a season (average 28 days). The total yield of sap per year varies between 28 - 165 liters per palm (average 75 liters palm⁻¹ year⁻¹). It takes 9 -10 days for the preparation of the inflorescence to initiate the secretion of sap by the 'kaiveddy' technique. The sap is collected both in the morning between 7 - 9 am (63 % of the yield) and evening between 3 -5 pm (35 % of the yield) and the rate of flow of sap is around 110 ml hour⁻¹.

AN ECONOMIC ANALYSIS OF CROP LIVESTOCK INTERGRATION IN VAVAUNIYA DISTRICT

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Farming system in the Dry Zone of Sri Lanka has different features. Through the years, the farmers have developed crop and livestock combination that gives high productivity and income. In the recent years the integration of crop and livestock appears to be breaking down. Only few farmers seemed to be practising integrated farming. The main objective of this study was to evaluate the economical feasibility of farming system prevailing in the Vavuniya district and to suggest methods for sustainable agriculture and improving the farms. The survey was carried out during February 1997. Personal interviews were conducted to collect the information from randomly selected thirty farmers in the Aasikkulam area. Tabular analysis and Gross marginal analysis (budgeting) were used as an analytical methods. Four types of crop and livestock intergration were observed, in the study area, based on cost during 1997 Type 1 (>70% for livestock and <30% for crop practised), Type 2 (35 - 50% for livestock and 50 - 60% for crop practised), Type 3 (< 30% for livestock and > 70% for crop practised), Type 4 (Non intergrated). The type 1 farms were efficient but only 15% of the farmers followed this combination. The return for acre of this farm was Rs 4,700 per month, which is double of the other farms. The rate of return to capital was 55.15% that is 21.58% higher than the other combinations. Type 2 and Type 3 intergrated farms account to be about 75%. They have sufficient resources, but their management was not efficient as they have their family labour and management alone. The risk averts of these farmers were high. Low price of milk, high prices of concentrates and non availability of grazing land were the major constrains in this area. The findings reveal the potentiality in improving crop and livestock's intergration in enhancing the sustainability of the farming system. There are possibilities to get the maximum utilization of these sources available in the farms, if suitable development programmes are integrated in these farms.

A TEST FOR RELATIVE EFFECTIVENESS OF MONETARY AND FISCAL POLICY IN SRI LANKA

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The objective of this study is to test empirically the relative effectiveness of fiscal and monetary policy in Sri Lanka from the period of 1950 - 1996.

Monetary policy in Sri Lanka

With the establishment of the Central Bank in 1950 monetary policy has gradually evolved to cover both economic stabilization and development objectives. After 1977, The central bank gradually moved away from direct control to more market oriented policy tools in monetary management with development of financial market in the country.

Fiscal policy in Sri Lanka

The post independence government played a key role in upliftment of the socioeconomic status of the people of Sri Lanka. The scope and involvement of the government as the biggest single spending unit and employer in the economy expanded until the end of the 1980. In recent years, the government decided to limit the direct involvement in the economic activities only to areas where private sectors are unable to perform satisfactorily in meeting society's needs.

Technique of multiple regression analysis has been used to test the relative effectiveness of monetary and fiscal policies in Sri Lanka over the period 1950 - 1996. Multiple regression analysis was done by OLS method. Assumptions for the OLS method were made in this multiple regression analysis.

Regression equation has been estimated in the first, second and central difference forms.

$$\Delta \text{GDP} = a_0 + a_1 \Delta E + a_2 \Delta B$$

GDP - Change in Gross Domestic Product; B - Monetary Base (Currency + Reserve);
E - Government Expenditure

Augmented Dicky Fuller (ADF) test was done to test the stationary of each variable. ADF test statistics showed that only second difference form was significant at 1% level. Therefore all the second difference form were stationary.

Cointegration test was done to the second difference equation. It showed that variables are not cointegrated.

Equation for the second difference form 1950 - 1977

$$\Delta \text{GDP} = 19920.36 + 0.619496 \Delta \text{E} + 11.72566^* \Delta \text{B}$$

$R^2 = 0.941208$; Adjusted $R^2 = 0.936096$; Durbin Watson static = 0.493953 and F statistic = 184.1061.

Equation for the second difference form (1978 - 1996)

$$\Delta \text{GDP} = 67505.92 + 1.138939^* \Delta \text{E} - 0.894169^* \Delta \text{B}$$

$R^2 = 0.971409$; Adjusted $R^2 = 0.967835$; Durbin Watson static = 1.309359; F statistic = 271.8040 and * - Significant at 1% level.

Durbin Watson value showed that there is no auto correlation effects in these two equations. The sign for the coefficient of ΔB and ΔE was positive in equation (1950 - 1977). The sign for the coefficient of ΔB and ΔE was negative and positive respectively in equation (1978 - 1996). In equation (1950 - 1977), coefficient of ΔB was significant at 1% level. In equation (1978 - 1996), coefficient of ΔB and ΔE was significant at 1% level. F statistic of two equation showed that the models were significant at 1% level.

Equation for the period of 1950 - 1977 indicates that monetary policy has been stronger than fiscal policy in Sri Lanka. Equation for the period of 1978 - 1996 indicates that fiscal policy has been stronger than monetary policy in Sri Lanka. After 1977 fiscal policy has been stronger than monetary policy because fiscal policy has increased the productive capacity of economy. The emphasis of the investment strategy was on the initial development of essential infrastructure through public investment so that the private sector would eventually take over the leading role in economic activities consequently. Until 1987 public investment was higher than the private investment. Due to gestation period of the public investment projects, the country encountered short term economic problems such as rapid inflation and fiscal and balance of payment imbalance. However the successful completion of these projects increase the capital stock of the country thereby enhancing the production capacity of the economy.

IMPACT OF TERMS OF TRADE ON ECONOMIC DEVELOPMENT IN SRI LANKA

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Agricultural growth is an essential pre requisite of high economic growth because the agricultural sector still plays a major role in the economy of Sri Lanka. At the time of independence, agriculture accounted for nearly 50% of country's GDP and in the 1995 it contributed to 20.6% of GDP. The rapid growth of the manufacturing sector in Sri Lanka has been a recent phenomenon, a direct result of the liberalization of the economy. The welfare of farmers is influenced by relative price movements of agricultural products. The ratio between farm and non farm price is referred to as the terms of trade of agriculture. An increase in the average level of farm prices and other goods and services in the economy leads to an improvement in the welfare of farmers and overall economic development. Objective of this study is to analyze the impact of agricultural favourable terms of trade on savings, gross capital formation and paddy production, which mainly indicate the economic development of Sri Lanka. For this study purpose, time series data were collected from the annual reports of Central Bank of Sri Lanka. Technique of linear regression analysis has been used to test the effectiveness of independent variable over the period of last 15 years (1980 - 1995). Function models are:

$$S_n = f(\text{GNP}, \text{TOT})$$

$$\text{CAP} = f(\text{GNP}, \text{TOT})$$

$$\Delta \text{PA} = f(\Delta \text{Log GNP}, \Delta \text{Log TOT})$$

where

S_n = National Savings; PA = Paddy Production; CAP = Gross Capital Formation; TOT = Terms of Trade and GNP = Gross National Product. The saving function shows 0.93 R^2 value and sign of coefficient was positive as expected in hypothesis. GNP and terms of trade show significance at 5% level. Elasticity for GNP is 3.5 and for the terms of trade is - 0.13. Increase of 1% of terms of trade decreases the savings by 0.13 and increase of 1% of GNP increases the savings by 3.5%. Ninety three percent of the variation in gross capital formation is explained by explanatory variables. GNP shows expected sign of positive and the terms of trade shows expected sign of negative. Both of these variables are significant at 5% level. Elasticity of GNP and terms of trade is 3.18 and - 0.19 respectively. Increase of 1% of terms of trade decreases the gross capital formation by 0.19% and increase of 1% of GNP increases the gross capital formation by 3.18%.

The R^2 value of change in paddy production function is also 0.80. The log value of change in GNP and log change in terms of trade show expected sign of positive at 5% level of significant. Elasticity of GNP and terms of trade is 16.98 and 8.42 respectively. Increase of 1% of log value of change in terms of trade increases the change in paddy production by 8.42% and increase of 1% of log value of change in GNP increases the

FOOD GRAIN PRICES AND ECONOMIC GROWTH IN SRI LANKA

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Food grains which are paddy and wheat are the staple food in Sri Lanka and their prices are crucial element in the Sri Lankan economy that effects the overall growth of the economy. Food grains occupy major proportion of the food budget of majority of population. Therefore, prices of food grains at the farm level and retail level have an important effect on the standard living of both rural and urban people. The main objective of this study is to analyze the relationship between food grain prices and economic growth in Sri Lanka during the period of 1980 - 1995. Data for this study were collected from the Annual Report of Central Bank of Sri Lanka. Paddy and wheat have been taken into analysis in this studies. The multiple regression technique has been used to analyze the relevant functions.

Function models are;

$$\Delta F_n = f(\Delta F_n_{(t-1)}, \Delta TOT_{(t-1)}, \Delta S_n, \Delta F_m)$$

$$\Delta GNP = f(\Delta GNP_{(t-1)}, \Delta F_n)$$

$$\Delta S_n = f(\Delta S_n_{(t-1)}, \Delta TOT_{(t-1)}, \Delta GNP_{(t-1)})$$

$$\Delta TOT = f(\Delta F_n, \Delta F_m, \Delta I_p, \Delta M_{(t-1)})$$

where, F_n = Food grain (paddy) production; TOT = Agricultural terms of trade; S_n = National savings; F_m = Imports to consumption ratio of food grain (paddy land wheat); GNP = Gross national product; M = Money supply and I_p = Manufactured product.

Analysis of functions show that the expected signs were observed for all coefficient correctly according to the hypothesis tested. R^2 value for the paddy production was 0.83. The sign of the coefficient of change in change of terms of trade and change in savings was positive and significant at 10 and 5% levels respectively. The change in change of paddy production sign was positive to the change in paddy production and significant at 5% level. The sign of the change in food grain imports to consumption ratio was negative and significant at 5% level. The coefficient of the change in change of the paddy production, change in change of terms of trade, and change in food grains imports to consumption were 0.46, 0.0018 and - 0.028 respectively. The variable national savings show very poor coefficient and Durbin Watson stat value is 1.9. This implies function has no autocorrelation problem. R^2 value for the function of change in GNP was 0.32 and all the coefficients showed expected signs. The change in change of GNP and change in paddy production positively correlated with change in GNP. Both of these are significant at 5% level. Coefficient of the change in change of GNP and change in paddy production were 0.43 and 34931.44 respectively. Durbin -Watson stat value was 0.46. This function also has no auto correlation effects. Sixty one percent of variation of the change in saving is explained by explanatory variables. The change in change of saving and change in change of GNP show expected positive sign and both are significant at 5% level. The change in change of terms of trade shows

negative sign at 10% level significant. Coefficient of the change in change of saving, change in change of terms of trade, change in change of GNP were 0.62, -2293.18 and 1.85 respectively. Durbin - Watson stat value was 1.6 and this function also has no auto correlation. Function of change in terms of trade shows poor correlation ($R^2 = 0.24$). All the explanatory variables show expected negative sign. The change food grain imports to consumption ratio only significant at 5% level and change in money supply are statistically significant at 5% level and change in paddy production change in money supply are statistically significant at 10% level. Coefficients of the change in paddy production and change in food grain imports to consumption ratio are -1.8 and -0.8 respectively. Coefficients of change in manufactured production and change in change of money supply are very poor. Durbin - Watson stat value was 1.04. Relative price movement of food grain - paddy - to manufactured goods show decline trend during the study period. This indicates that this declining trend in the economy obviously would lead to deterioration of welfare of farmers through the loss of income. This phenomenon adversely affect the real economic growth of Sri Lanka since it consists an agricultural based economy. Food grain production is statistically contributed to GNP growth. National savings does not contributed well to the food grain sector. This explain that most of the savings have been siphoned out to the manufacturing sector rather than to the food grain sector. Food grain prices in Sri Lankan economy is being distorted by government intervention such as import policy and subsidy schemes.

FIELD CROP SEED STORAGE METHODS PRACTISED IN JAFFNA REGION

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In Sri Lanka, Jaffna district is one of the major crops producing area. Rice is cultivated in large scale and cereals, vegetables and fruit crops are also cultivated in Jaffna region. Some specific varieties of field crops are cultivated in this region. One generation after another without having any considerable germplasm conservation methods. The post-harvest storage period of field crops are depending on harvesting maturity, time of harvesting, rate of cooling of product, storage temperature and relative humidity. Some traditional methods for conservation of germplasm of field crops are being used by the Jaffna community and must satisfy the recommended storage conditions. A survey was conducted to identify different types of storage structures for various seeds which are being practiced for a long period in Jaffna. For this fifteen methods were evaluated for the last three years and three areas (Kodikamam, Manthikai and Thavady) were selected to cover the entire area of Jaffna region and in each area, the information related to different types of traditional storage structures were collected from the farmers and recorded. Based on the survey, different types of effective traditional storage methods were identified.

COMPARISON OF SEED-BED PREPARATION FOR BLACK CHEWING TOBACCO SEEDLINGS IN TWO DIFFERENT SOIL TYPES IN VADAMARADCHI

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Black chewing tobacco seed-bed preparation in two different soil types, red-soil and sandy-soil were identified as popular areas for large scale commercial seedlings production during Maha season in Vadammaradchi. The environmental and climatic conditions in which low temperature 25°C, slight breezing maximum 2.0 km h⁻¹ and night cooling 22°C were suitable for seedlings. High technique routine agronomic practices on land preparation, removal of soil clods and stones, leveling and compaction, addition of stored dried green manure, six months old cow-dung compact, nine months old goat-dung compost and sub-soil cover were critically analysed to achieve the maximum level of quality seed-bed yielding healthy seedling. In red-soil, 2.5 cm depth of cow-dung and 2.5 cm goat-dung and 0.5 cm sub-soil cover were ideal for bed with compacted base soil layer preventing tap-root penetration into the soil. A perfect root system was shown nutrotropism of tap root during uprooting seedlings. In sandy soil, 7.5 cm depth of cow-dung and 2.5 cm goat-dung without sub-soil cover were ideal for bed. It was found that more lateral and fibrous roots were developed. Seedlings have no contact with soil layer facilitating easy removal of seedlings without taproot damage that were observed. Sandy-soil is more acceptable for black chewing tobacco seedlings production in large scale based on agribusiness.

DESIGN DEVELOPMENT AND EVALUATION OF A GREEN FRIDGE SUITABLE FOR SMALL SCALE VEGETABLE STALLS IN SRI LANKA

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Postharvest losses of fruits and vegetables are estimated to be about 30 to 40% of the total production of Sri Lanka. These losses occur at almost all steps in the distribution channel of fruits and vegetables in different intensities. A low cost, technically feasible and environmentally friendly vegetable storage structure was designed to reduce the loss while enhancing the postharvest life and quality of perishables at the retail level. The sources of energy for the instrument are the wind power throughout the day and the combination of wind power and solar energy during the day time. The result reveals that 16°F reduction in internal temperature could be maintained with the high humidity of 90 to 95% in the storage chamber. The structure facilitated to increase the post harvest storage period by 3-4 days than the open atmospheric storage.

A STUDY ON THE INCIDENCE OF DROUGHT AT PELWATTE SUGAR CANE PLANTATION

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The availability of moisture is a vital factor in crop growth. This availability depends principally on three factors, namely rainfall, soil and plant characteristics. Drought is the condition where moisture is not available for a plant and likewise depends on rainfall, soil and crop characteristics. Drought analysis demarcates the time frame for planting, after care operation, harvesting and efficient irrigation schedule. In the study, the incidence of drought has been analyzed purely using rainfall data. The average daily rainfall data of Pelwatte Sugar Cane Plantation (duration of 15 years) were used to explain the drought spell. A threshold value of less than 6 mm day^{-1} was chosen to identify non rainy day from rainy day. In direct analysis, 75% probability of drought incidence was less than 3 consecutive days in all months except June, July and August which had the values of 15, 4 and 4 days respectively. Considering consecutive 10 days drought, since usual irrigation interval is 10 days, highest value was obtained in the month of April and November. These results showed that rainfall was inadequate for crop establishment and growth or in other terms crop failure may occur one year out of 20 years in April planting and one year out of 10 years in November planting crop in rainfed sugar cultivation. Occurrence of drought incidence for every month and year were modeled using the two parameter gamma distribution function. In this modeling approach, the result showed the ability of the model to predict incidence of drought with high correlation of observed and predicated values. These models proved good descriptions of the occurrence of drought over limited periods and the parameters vary with time, would provide useful description of the pattern of drought throughout the year.

RAINFALL PROBABILITY ANALYSIS FOR PELWATTE SUGAR CANE PLANTATION

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The production of sugar cane under rainfed condition is affected by the rainfall, being a chief limiting climatic factor at Pelwatte, Sri Lanka. This uncertain rainfall, in its length, quantity and distribution creates a moisture deficit at different stages of the sugar cane crop and ultimately results in a considerable loss in the cane yield. This can be overcome by selecting appropriate planting and harvesting dates to ensure the utility of every drop of incident rainfall that falls on land to its maximum. A study was undertaken to statistically analyze the available rainfall data of Pelwatte Sugar Cane Plantation using 1:1 rainfall confidence limits and probability density function of gamma distribution. The results of 1:1 rainfall confidence limits showed that seasonal cycles as most pertinent, break of seasons and torrential rains. The values of these confidence limits were used for selecting suitable planting and harvesting dates. A reliable choice of planting dates could be the early part of October for the Maha planted crop and early part of April for the Yala planted crop. Harvesting of Maha crop could be done during the period of 24th to 27th week and then 31st to 33rd week of an year. The period in between 27th week to 31st week should be avoided in order to circumvent problems of experiencing unusual rains. Similarly, Yala harvesting can be done during 5th week to 9th week of a year. A two parameter gamma probability model was fitted to the annual pattern of the catchment with a mean amount of 2.3 mm rainfall per rainy day and 0.5914 of shape factor. The observed and predicted results using the model showed a significant correlation ($r^2 = 98.93$). This correlation explains that the probability of occurrence of daily rainfall can be reliably modeled by using two parameter gamma probability density function. The modeling approach has considerable potential for comparing sites and classifying rainfall regimes, and a vital component of agricultural research and development.

A STUDY ON PRODUCTION SYSTEM OF MILK BREEDS OF GOATS IN JAFFNA DISTRICT

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The study was mainly focused on the production system of milk breeds of goats of Jaffna district to determine constraints faced by goat breeders and to evolve remedial measures. A cross sectional survey was conducted in Jaffna veterinary range from July to September 1994, using a questionnaire in 150 randomly selected goat flocks to study different aspects of production system. Data were extracted from records maintained at Veterinary Surgeon's Office, Jaffna and Artificial Insemination Center, Thirunelvely. Non - availability of adequate lands and forages, lack of housing for follower stock, constraints in management practices when flock size was increased and problems of marketing of the products, limited the size of the sampled flocks. Majority of sampled flocks were raised under intensive system. Concentrate was fed only for pregnant and lactating does. Even though Saanan breed performed better than Jamunapari in milk production, Jaffna farmers preferred to Jamunapari owing to its dual purpose characteristics for milk and meat, which had better marketing prospects than Saanan. Majority of the farmers (68.6%) were aware of the importance of feeding colostrum to kids and they weaned the kids at 3 months of age. Many farmers (63.3%) preferred artificial insemination to natural breeding to breed their does. However, conception rates achieved by this method of breeding were low due to inefficient oestrus detection, non - availability and poor quality semen, delayed insemination etc. Inadequate efficient marketing system for disposal of kids and goat's milk had become a detrimental factor on the expansion of the goat industry in Jaffna.

SCIENCE ASSOCIATION

IMPACT OF ARTIFICIAL INSEMINATION AND REPRODUCTIVE PERFORMANCE IN DAIRY CATTLE OF KALAWANCHIKUDY VS. RANGE OF BATTICALOA DISTRICT

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A study to assess the impact of artificial insemination and reproductive performance in dairy cattle was conducted at Kalawanchikudy Veterinary range of Batticaloa district. A cross sectional survey of 245 dairy herds, rendered with artificial insemination services for the period from November 1982 till June 1985, was carried out for two months. Records of all inseminations were cross - checked with available documented information with farmers and data were extracted. Outcome of each insemination and details of all AI born calves were obtained. Low re - insemination figure (246 instead of being not less than 520 second, third and fourth AI) associated with poor conception rate (25.0%) to first AI indicated that AI services were not very satisfactory in this range. Increase in availability of forage following monsoonal rains improved the nutritional status of the cows. Much attention was paid by the owners on their livestock and estrus detection after harvesting of paddy in May. The above two factors significantly increased ($P < 0.001$) the number of inseminations during dry season as compared to rainy season. 22.4% of AI born calves were produced by not conforming to national breeding policy which resulted in undesirable outcome due to high degree of upgrading and inadaptability of the offspring to climate conditions. Similarly 14.0% of AI born calves produced showed tendency of small upgrading or even downgrading. 11.8% mortality and disposal of AI born calves for beef (17.0%) made efforts taken in upgrading programme fruitless. Lengthening of calving interval (413.6 ± 59.7 days) was attributed to poor heat detection rate (39.8%), farmers policy to breed late after calving, poor conception rate to first AI and increased number of services per conception (4.04%). The entire efforts taken in AI programme would end up in disaster if these fertility parameters are not improved.

SURVEY ON PRODUCTION CHARACTERISTICS AND MANAGEMENT PRACTICES OF SWINE HERDS OF WESTERN PROVINCE OF SRI LANKA

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A cross sectional survey was carried out in 162 randomly selected swine herds from Colombo, Gampaha and Kalutara districts of Western Province using a questionnaire during August to October 1998 to study the reproductive performance and management practices adopted. Large white x Landrace cross breeds consisted 33.3% of the sampled herds. The average herd size was 38 and sows and gilts constituted 17.7% of the sampled population. The average litter size was 10.0 ± 2.0 ranging from 6 to 15 piglings per litter. The birth weight of piglings was 1.05 ± 0.23 kg ranging from 0.6 to 1.5 kg. Piglings were weaned at a mean age of 1.65 ± 0.42 months having a mean weight of 10.3 ± 3.5 kg. Pre - weaning and post - weaning growth rates were 188.8 ± 76.0 and 381.0 ± 22.0 g per day respectively. The age at first service of gilt was 8.4 ± 1.4 months and sows had an interfarrowing interval of 6.4 ± 1.5 months. The average litter size at weaning was 9.0 ± 2.0 months with a live weight of 80.1 ± 16.2 kg. Sows were culled at an age of 34.9 ± 10.4 months and the number of farrowings per sow was 4.3 ± 1.5 . The age of boars at first service was 9.5 ± 1.8 months and these were culled at a mean age of 33.6 ± 11.0 months.

REPRODUCTIVE PERFORMANCE OF DAIRY GOATS IN JAFFNA DISTRICT

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A study was conducted to evaluate the reproductive performance of dairy goats rendered with artificial insemination services for the period from October 1992 to September 1994.

A cross - sectional survey was conducted using a questionnaire, in 150 randomly selected goat flocks in Jaffna veterinary range from July to September 1994. Records of inseminations maintained at the veterinary office were cross checked with documents available with the owners for data collection. Undesirable effects such as chill, health hazards etc. due to rain on survivability of kids were minimised by properly planned breeding to result kidding at the end of the rainy season. Anoestrus due to suckling and lactation caused delayed post-partum first oestrus by more than 3 months. Farmers were mainly concerned about milk production than the reproductive efficiency and as a result they bred their does 5 to 6 months postpartum when the milk yield was very low. These factors resulted in lengthening of kidding to first service interval. Inefficient oestrus detection, untimely insemination, faulty techniques of insemination, poor handling of semen and failure of early pregnancy diagnosis contributed for higher services per conception and prolonged inter service interval. These resulted in increased kidding to conception interval thereby lengthening kidding interval. The conception rate was reported to be high when inseminations on two consecutive days were done. High preference was shown for Jamunapari semen for breeding owing to its high marketing demand than other breeds.

EFFECT OF PHYSICAL TREATMENT AND PROTEIN SUPPLEMENTATION ON VOLUNTARY FEED INTAKE AND DIGESTIBILITY OF RICE STRAW IN INDIGENOUS CATTLE

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Two feeding experiments were conducted to study the effect of physical treatment and protein supplementation on voluntary feed intake and digestibility of rice straw. In the first experiment, eight uncastrated 8 - 10 months old bull calves were selected and were randomly allocated to two groups of four calves each. One group received chopped straw while the other group was given long normal straw for a period of four weeks. Both groups received a basal ration. Straw was offered ad libitum. Daily voluntary intake and weekly weight gains were measured. For the second experiment, four ten month old bull calves were used in 4 x 4 Latin Square design to study the effect of supplementation of the straw chopped and offered ad libitum as a basal diet. Four treatments were; untreated straw, 4% urea with straw, coconut oil meal (400 g / head / d) with straw and leucaena leaf meal (300 g / head / d) with straw. After an adaptation period of 14 days for each treatment, daily feed intake and daily excretion of faeces and urine were measured for 7 days for every treatment. Chopped straw significantly ($P < 0.05$) increased the dry matter (1275.27 g / animal / day). Further, urea and leucaena leaf meal increased the straw dry matter intake (1.96 kg / animal / day; 1.64 kg / animal / day respectively) significantly ($P < 0.05$) when compared to straw only ration (1.48 kg / animal / day). However, urea treated straw gave higher dry matter intake than leucaena leaf meal supplemented straw but not statistically significant ($P > 0.05$). Further urea, coconut oil meal and leucaena leaf meal supplemented ration increased significantly ($P < 0.05$) both the dry matter digestibility (63.0, 62.0 and 65.0% respectively) and nitrogen retention as a percentage of total nitrogen intake (27.4, 28.4 and 34.6% respectively). However organic matter digestibility was significantly higher ($P < 0.05$) only for leucaena leaf meal supplemented ration (63.0%) as compared to straw only ration (56.0%). Leucaena leaf meal and coconut oil meal gave significantly higher ($P < 0.05$) crude protein digestibility (57.0 and 51.0% respectively) when compared to straw only ration (31.0%).

EPIDEMIOLOGICAL INVESTIGATION INTO THE OUTBREAK OF RINDERPEST IN BATTICALOA DISTRICT OF SRI LANKA

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The study dealt with the epidemiological investigation into the outbreak and the control of an unknown killer disease among cattle in peninsula region of Batticaloa district. Data were collected from the herds of the affected villages using a questionnaire to study the pattern of outbreak of this disease. Forty eight post-mortem examinations were conducted. Samples were sent to Indian Veterinary Research Institute and Animal Virus Research Institute, Pirbright which confirmed the disease as Rinderpest. The primary foci of infection was traced to a herd, that had close contact with goats imported from India for the Indian Army. This herd contracted the disease on 15th of October 1987 which spread rapidly to other herds. The study revealed about the intermingling of Indian goats with village cattle population as a consequence to exchange of these goats for chicken and fish by the Indian army and grazing of these goats in common grazing grounds of village cattle. The disease was characterised by high fever, diarrhoea, profuse lacrimation, stomatitis and affecting all age groups of cattle. The carcasses were dehydrated, emaciated, soiled and fetid and post-mortem examination in 88.9% of carcasses showed erosions and ulcers of abomasum, haemorrhagic and necrotic lesions of small intestine markedly in peyer's patches, and prominent stripes resembling 'zebra markings' or 'tiger stripes' in caecum, caeco - colic junction and rectum. In this outbreak, 509 cattle of all ages were affected from ten contiguous villages and 310 cattle died with morbidity and mortality rates of 40.1 and 24.4% respectively. Case fertility rate was 60.9% and European cross - breeds had higher morbidity rate of 64.1 % as compared to 37.0% in zebu cattle. Based on epidemiological information, characteristic clinical signs and post-mortem lesions, the disease was suspected to be Rinderpest. Slaughter policy introduced, even before the laboratory confirmation of the disease, effectively controlled the disease outbreak and no more fresh cases reported in the affected areas.

EPIDEMIOLOGICAL STUDY OF CALF MORTALITY IN JAFFNA DAIRY HERDS

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A cross - sectional survey using a questionnaire followed by longitudinal studies was carried out, in 21 sentinel herds and 54 sampled stall fed dairy herds, to study the epidemiological aspects of calf mortality. Prenatal and postnatal losses were recorded. Prenatal mortality rate was 3.92%. Stillbirth constituted 81.25% of prenatal deaths and was associated with dystocia. Low neonatal mortality rate of 4.1% was characteristic feature in these herds. Highest neonatal mortality rates occurring during the months of July, August and September (10.56, 8.7 and 13.33% respectively) could be due to adverse effects of the nutritional status of the dams during their pregnancy. The effect of monsoonal rains on the epidemiology of gastrointestinal neomatodal infestation probably caused heavy mortalities among calves over 8 weeks of age during the months of November, December and January (9.68, 16.67 and 20.0% respectively). Faecal examination of calves revealed heavy worm burden with trichostrongyle and strongyloid group of helminths during this period. Cause - specific mortality rates in calves due to the Debility and Paresis, gastrointestinal parasitism, enteritis, pneumonia, avitamimosis A and other causes were respectively 11.7, 17.6, 3.0, 1.5, 1.5 and 0.37%. Twenty nine out of 57 weak calves born during the dry season developed clinical signs associated with vitamin A deficiency. Twenty six calves which were treated with cod liver drench and vitamin A injections recovered whereas all three untreated calves died. Out of 95 calf deaths during the period of study, 49 deaths were from weak calves. Hypovitaminosis A could probably be a major factor influencing birth of weak calves and in determining overall calf mortalities. Calves from old dams showed high percentage of weaklings and postnatal deaths. Lack of awareness for feeding colostrum and commercial oriented milk production caused heavy postnatal losses. Improved managerial care of dams and new-borns, planned breeding to reduce effect climatic stresses on calf crop and optimum utilisation of available feed resources are very vital measures in control of calf losses.

A STUDY ON THE PRODUCTION SYSTEM OF INDIGENOUS GOATS OF KILINCHCHI

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A study was conducted to evaluate the constraints affecting goat production system in Kilinochchi. A cross-sectional survey was conducted on 200 sampled flocks in Kilinochchi veterinary range using a questionnaire followed by longitudinal studies in three flocks located at the University farm, Murukandy and Visvamadu. Progressive reduction in size of flocks was observed in the area of study. This could be attributed to development of irrigation schemes, intensive cultivation and introduction of exotic diseases such as goat pox and rinderpest subsequent to importation of goats from India by Indian Peace Keeping Forces in 1987. Majority of the farmers (78.5%) practised semi-intensive system of management. Thirty five percentage (35.0%) of the breeding females in the sampled flocks were without housing which resulted in heavy neonatal mortalities (27.6%) during rainy season and reduced number of follower stock. Natural breeding was adopted commonly but there was acute shortage of upgraded bucks for this purpose. Majority of breeding females were bred with inferior quality bucks while being grazed in pasture land. This led to inbreeding problems, high prenatal and postnatal mortalities and low production characteristics. Most of the owners were unable to get satisfactory veterinary services due to shortage of veterinary staff and lack of awareness about veterinary services. Goat breeders faced tremendous constraints in marketing of milk, surplus and culled females and generally middlemen exploited them. The productivity and profitability of the goat production could be improved by introducing efficient management techniques and by development of efficient marketing system.

SOME ASPECTS OF PRODUCTION PERFORMANCE OF BULL MOTHER HERD OF SRI LANKA SWISS LIVESTOCK DEVELOPMENT PROJECT - POLONNARUWA DISTRICT

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An evaluation was made on the production characteristics of bull mother herd of Sri Lanka Swiss Live stock Development Project. Data were obtained from the relevant records and registers maintained at bull mother farm from 1980 to 1986. Data on management practices were collated in consultation with the project management staff. The data were collected and analysed. The birth weights, ranged from 14 to 31 kg with the mean of 20.7 ± 3.2 kg, for European cross - breeds were significantly higher than that of Indian Zebu ($P < 0.05$) which ranged from 16 to 20 kg with the mean of 17.2 ± 1.7 kg. This could be attributed to their genetic merits. A significant and positive influence of the birth weight on weight gain was found in this herd ($r = 0.4590$ to 0.7491). The factors such as season, age, sex and breed were not found to have any significant influence on weight gain. However, calves of European cross exhibited superiority over Indian Zebu calves on weight gain and the corresponding values for European cross and Indian Zebu were 2.68 ± 0.46 and 1.86 ± 0.08 kg / Week respectively. Further weight gain in calves increased up to first twenty four weeks which then gradually declined with ages. The lactation length, ranged from 228 to 384 days with the mean of 304.9 ± 32.7 days, for European cross breeds was superior to that of Indian Zebu and local Zebu having lactation lengths of 297.2 ± 44 and 294.4 ± 43.5 days respectively. However there were no significant variations of this parameter observed among these breeds in this herd. The superior performance of the local and Indian Zebu breeds in lactation length, as compared to these breeds in other farms, could be attributed to selection of these animals, other management practices including feeding etc. carried out in this herd.

STUDY OF SEMEN CHARACTERISTICS OF BULLS MAINTAINED AT ARTIFICIAL INSEMINATION STATION - POLONNARUWA

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The study was focused on important characteristics of semen produced by the artificial insemination centre at Polonnaruwa. Data were extracted from records and registers maintained at the semen processing laboratory for the period from 1980 to 1986. This included 651 ejaculates of semen from different breeds. Volume, density, mass activity, sperm concentration and sperm motility both initial and after processing were statistically analysed. The study revealed that semen characteristics depended upon breeds and their mean values for the Jersey, European cross bred, Sunandini and Sindhi were, respectively; volume 3.23 ± 1.25 , 3.86 ± 1.06 , 3.93 ± 1.17 and 1.75 ± 0.6 (ml); semen density 3.00 ± 0.61 , 3.11 ± 0.65 , 3.76 ± 0.44 and 3.33 ± 0.62 ; mass activity 2.71 ± 0.47 , 2.70 ± 0.61 , 3.01 ± 0.47 and 2.83 ± 0.37 ; sperm concentration 834.33 ± 266.4 , 652.38 ± 190.66 , 1102.49 ± 321.64 and 557.14 ± 112.97 (600 sp / mm³); initial sperm motility 73.33 ± 6.91 , 65.28 ± 8.63 , 75.38 ± 6.25 and 69.58 ± 5.94 (%); motility after one day after processing 56.84, 58.5, 61.94 and 59.0 (%); motility one week after processing 54.72, 56.17, 59.78 and 57.5 (%). With regards to semen quality, superiority of Sunandini over other breeds was illustrated by larger volume of ejaculate, higher density, mass activity, concentration and initial motility of the sperm and better preservability of sperm motility. European cross breeds with low mass activity, sperm concentration and initial motility indicated poor quality semen as compared to pure Jersey breed. However, analysis revealed that sperm motility of Jersey bulls suffered significant losses during storage due to adverse effect of tropical conditions on this breed. But the cross breeds showed superiority in preserving sperm motility because of their cold shock resistance and adaptability. The analysis also indicated that the volume and density of semen, mass activity and sperm concentration were significantly and positively influenced by the age of bulls. Effect of age would be the probable reason for low quality semen from Sindhi bulls. No significant correlations of sperm motility and preservability of sperm motility with age of the bulls were found in this study.

WHEY HYDROLYSATE MEDIUM FOR LACTIC ACID PRODUCTION BY *LACTOBACILLUS CASEI*

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A whey based medium was formulated for lactic acid production. Whey contains lactose 3% (w/v), lactalbumin and lactoglobulin as major protein fraction, minerals, and vitamins. Lactic acid bacteria are very fastidious with respect to their nutritional requirement and function best in media having yeast extract. However supplementation of whey with 10 g l⁻¹ yeast extract increases 33% of the production cost. Thus the use of whey proteins were tried. Lactalbumin and lactoglobulin present in whey were hydrolyzed by an endoprotease, neutrase (0.5 Anson Unit g⁻¹), at pH 6.5 and 45°C. Different amounts of neutrase was added to whey and at various time intervals proteolysis was terminated by boiling the hydrolysate. Addition of 10 ml enzyme per liter whey and proteolysis for 5.5 h gave highest productivity 2.2 g l⁻¹ h⁻¹ with complete substrate utilization while 0.7 g l⁻¹ h⁻¹ lactic acid productivity was obtained when the unhydrolysed whey was used as the medium. Supplementation of whey hydrolysate with Mn²⁺ (0.18mM) increased the cell growth and lactic acid productivity. When yeast extract 2.5 g l⁻¹ was added to whey hydrolysate along with Mn²⁺ (0.18mM), further increase in productivity to 3.1 g l⁻¹ h⁻¹ with increased cell growth (4.4 g dry weight l⁻¹) were observed. When the concentrated hydrolysate (by freeze drying, total sugar level was 70 g l⁻¹) was used as the medium, the productivity increased to 4.1 g l⁻¹ h⁻¹ with complete substrate utilization and increased biomass (5.1 g l⁻¹ dry weight). When whey hydrolysate medium (not concentrated) was supplemented with lactose (total sugar level to 100 g l⁻¹) the productivity was similar to that obtained in whey hydrolysate medium. These results show that lactic acid productivity could be increased by concentrating the whey while avoiding the yeast extract supplementation.

COMPARISON OF LACTIC ACID PRODUCTION BY IMMOBILIZED AND FREE CELLS OF *LACTOBACILLUS CASEI*

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In conventional batch fermentation processes for lactic acid production, reduction in cell growth due to severe product inhibition is observed. Intensification of the process to increase the productivity is thus needed to make it economical. In this study, lactic acid production by recycle batch fermentation using immobilized cells *L. casei* was compared with batch fermentation. Fermentation set up for recycle batch fermentation contained a jacketed column reactor packed with 2% (w/v) polyethyleneimine (PEI) coated foam glass Pora - back A beads and the column was connected to a jacketed stirred tank fermentor containing the fermentation medium. The stirred tank fermentor was equipped with automatic pH control, sampling device etc. Batch fermentation was carried out in a fermentor at 42°C with continuous stirring at 250 rpm and at constant pH (6.0) by automatic titration using 6M NH₄OH. Fermentation medium (pH 6.0) contained (g l⁻¹) glucose, 95; KH₂PO₄, 0.5; sodium citrate, 1.0; MgSO₄ · 7H₂O, 0.05; MnSO₄ · H₂O, 0.0031; FeSO₄ · 7H₂O, 0.002 and ascorbic acid, 0.005. In batch fermentation, when the substrate concentration was increased from 25 to 75 g l⁻¹, the free cells utilized the entire substrate and the productivity was increased from 1.6 to 3.3 g l⁻¹h⁻¹. Further increase in substrate concentration above 75 g l⁻¹ decreased the productivity with incomplete substrate utilization. In contrast, in the recycle batch fermentation, the immobilized cells gave higher productivities at the substrate concentrations from 25 to 75 g l⁻¹ (from 3.8 and 3.6 g l⁻¹ h⁻¹) than in batch fermentation. Even at substrate concentrations above 75 g l⁻¹ (at 100 and 125 g l⁻¹) entire substrate was utilized but the productivities were reduced. When the fermentation was carried out at different pH values, at pH 6.0 and 5.5 only lactic acid was produced and the lactic acid productivities by the free cells were 2.2 and 1.8 g l⁻¹ h⁻¹ when 50 g l⁻¹ substrate was used. But immobilized cells produced lactic acid alone at pH 6.0, above and below this pH acetate and formate were also detected. However highest productivity of 3 g l⁻¹ h⁻¹ was obtained at pH 7.0 by immobilized cells when 100 g l⁻¹ substrate was used. When the yeast extract concentration in the medium was decreased from 10 to 5 g l⁻¹ while the substrate concentration was 100 g l⁻¹, the free cells gave 1.7 and 1.2 g l⁻¹ h⁻¹ productivities respectively with incomplete substrate utilization. But immobilized cells utilized the entire substrate and the productivities obtained were 2.8 and 2.2 g l⁻¹ h⁻¹ respectively when 10 and 5 g l⁻¹ yeast extract was supplemented. Under the above conditions the total sugar concentration was mentioned as substrate concentration and glucose to lactose ratio was 19:1. These results show that lactic acid could be produced efficiently and economically using immobilized cells.

MINIMIZING THE PROTEOLYTIC ACTIVITY OF ACID PROTEASE PRODUCED BY *ASPERGILLUS NIGER*

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Acid protease produced from *Aspergillus niger* shows both proteolytic and clotting activities. A suitable enzyme that could be used for cheese making should have decreased proteolytic activity with high clotting activity. If the proteolytic activity is high, the properties of the cheese prepared will be altered and would affect the standard cheese preparation such as excessive digestion of curd and less retention of fat in cheese. This will also leads to adverse effects on the body and flavour of the ripened cheese. Thus it is important to minimize the proteolytic activity. In this study our aim is to modify a protease produced from *Aspergillus niger* for cheese making. With a view to bring our enzyme very close to calf rennet, attempts were made to increased the ratio of milk clotting to proteolytic activity by adding some metal salts. Clotting activity was increased by the addition of $ZnCl_2$, $CaCl_2$ and $ZnCl_2 + CaCl_2$ by 66, 25 and 42% respectively and there was no loss in clotting activity at 5 h. At 60 min and $55^\circ C$, 46% of the proteolytic activity was lost while the clotting activity of the enzyme was 166%. The proteolytic activity was increased by calcium ions, whereas clotting activity was influenced by Ca^{++} , Zn^{++} and $Ca^{++} + Zn^{++}$. When the crude culture supernatant was incubated with $CaCl_2$ for 5 h at pH 4.5 and $55^\circ C$, at zero time, proteolytic activity was increased by 10% and remained the same for 30 min. However further increase in incubation time decreased the proteolytic activity. In the control proteolytic activity decreased by 40% at 1 h and 100% at 5 h. Thus addition of Zn^{++} had no stabilizing effect on proteolytic activity. Acid protease lost 46% of the activity at 1 h and 100% of the activity at 5 h. How ever addition of $ZnCl_2 + CaCl_2$ retained 80% of the proteolytic activity at 5 h. From the results it can be concluded that Zn^{++} is sufficient to increase the clotting activity without influencing the proteolytic activity.

EFFECT OF DIFFERENT INDUCERS ON ACID PROTEASE PRODUCTION BY *ASPERGILLUS NIGER* IN SOLID MEDIUM

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When *Aspergillus niger* CISIR N4 was grown in a solid basal medium containing (g kg^{-1}) KH_2PO_4 (0.5); FeSO_4 (0.01); MgSO_4 (0.5), KCl (0.5); NH_4NO_3 (3.0); soy flour (20.0); starch (15.0) and rice bran (903.0) at 30°C , $417.3 \text{ SU g DMB}^{-1}$ (Dry Mouldy Bran) clotting and $9.0 \text{ PU g DMB}^{-1}$ proteolytic activities were obtained at 48 h. To increase the acid protease production, different inducers (tryptone, gluten, sodium glutamate, casein and egg albumin, 20 g kg^{-1}) were added to the basal medium. Highest clotting ($1410.9 \text{ SU g DMB}^{-1}$) and proteolytic ($28.3 \text{ PU g DMB}^{-1}$) activities were obtained at 48 h in the basal medium containing gluten followed by casein, tryptone, sodium glutamate and egg albumin. Hence, the optimum gluten concentration was determined. When gluten concentration was increased from 0.0 to 10 g kg^{-1} clotting activity was increased from 597.6 to $1718.4 \text{ SU g DMB}^{-1}$ while the proteolytic activity was increased from 22.0 to $29.8 \text{ PU g DMB}^{-1}$. However further increase in gluten concentration above 10 g kg^{-1} led to the decrease in clotting and proteolytic activities production. Further, increase in gluten concentration above 5.0 g kg^{-1} reduced the time taken for the production of maximum clotting and proteolytic activities from 48 h to 40 h. From these results $10 \text{ g gluten kg basal medium}^{-1}$ was selected as the optimum concentration. Decrease in the production of clotting and proteolytic activities in basal medium containing the gluten concentration of 10 g kg^{-1} or could be due to the limitation of nitrogen source (soy flour). Thus the optimized gluten concentration was taken with different concentration of soy flour in the basal medium. Increase in soy flour concentration from 0 to 200 g kg^{-1} increased the proteolytic and clotting activities from 14.0 to $275 \text{ PU g DMB}^{-1}$ and 327.7 to $1728.2 \text{ SU g DMB}^{-1}$ respectively. Hence 200 g soy flour was added to $1.0 \text{ kg basal medium}$ instead of 20 g , with 10 g kg^{-1} gluten.

CONTINUOUS PRODUCTION OF ACID PROTEASE BY SOLID STATE FERMENTATION

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Continuous acid protease production from *Aspergillus niger* N4 by solid state fermentation was studied in optimized medium containing (g kg^{-1}) KH_2PO_4 (0.5); FeSO_4 (0.01); MgSO_4 (0.5), KCl (0.5); NH_4NO_3 (3.0); soy flour (200.0); starch (5.0) gluten (10.0) and rice bran (903.0) at 30°C . Maximum clotting ($437.6 \text{ SU g}^{-1} \text{ DMB}^{-1}$) and proteolytic ($9.4 \text{ FU g}^{-1} \text{ DMB}^{-1}$) activities were obtained at 48h when the initial spore density was 5×10^6 spores g medium^{-1} . For scaling up of the process, preparation of large number of spore inoculum is difficult. Hence the use of mycelial inoculum and continuous recycling of the biomass were studied as an alternative. Mycelial inoculum of 12h old and 5% (w/w) was the best for maximum production of acid protease clotting activity ($471.6 \text{ SU g}^{-1} \text{ DMB}^{-1}$). To study the continuous production of acid protease, for first flask, spores were used as inoculum. After 12h of incubation at 30°C , 2.5 g of mouldy bran was withdrawn from the first flask and inoculated to the second flask containing fresh optimized medium (47.5 g). Likewise from the second flask 2.5 g of mouldy bran was withdrawn and inoculated to the third flask containing fresh optimized medium (47.5 g). Similarly another eight sets of flasks containing optimized medium (47.5 g) were inoculated with 12h old mouldy bran (mycelial inoculum) from the previous batch. Maximum clotting activity obtained in the first and 2nd batches were $1998.5 \text{ SU g DMB}^{-1}$ and $3473.4 \text{ SU g DMB}^{-1}$ respectively. However from 3rd batch maximum clotting activity obtained started to decrease gradually and in the 11th batch only $654 \text{ SU g}^{-1} \text{ DMB}^{-1}$ clotting activity was obtained. Similar activities were obtained for proteolytic activity too. However up to 5th batch proteolytic and clotting activities obtained were more than or equal to that obtained with spore inoculum. Hence it is possible to use mycelial inoculum instead of spore inoculum and continuous operation of the process for at least five cycles is also possible.

MALTING OF RICE AND STUDIES ON ITS AMYLASE

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Cereal malts are important sources of amylases, which could be used in the food industry. This paper presents the extraction and kinetic studies carried out with rice malt amylase. Germination of rice grains was carried out by soaking the grains in distilled water containing 0.10 g l^{-1} sodium metabisulphite for 12 hours, then drained and allowed to germinate in a moistened bag and kept in dark at room temperature for five days. The starch hydrolyzing activity started to increase on the 2nd day and continuously increased for 7 days (the measurement was carried out for 7 days). Since, the enzyme activity difference between fourth and fifth days was insignificant, it was decided to arrest the germination on the fourth day. The malted rice was dried in the sunlight and powdered at room temperature in a domestic grinder. The amylase from rice malt powder (1.0 g) was extracted by suspending it in 10.0 ml of distilled water 9.0 g l^{-1} NaCl, 1.0 g l^{-1} CaCl_2 and 0.01M buffer separately. High activity of amylase was achieved in 11 g l^{-1} NaCl. Then, the kinetic properties of the rice malt amylase was studied. The optimum pH and temperature for the activity of malt amylase were 5.0 and 60°C respectively. To determine the best buffer for malt amylase activity, citrate - phosphate (pH 5.0) and acetate (pH 5.0) buffers having the same ionic strength or concentrations were used. The enzyme activity was best in acetate buffer. Addition of 0.1 g l^{-1} CaCl_2 to the acetate buffer (pH 5.0), enhanced the malt amylase activity. This enzyme was stable at 4 and 30°C for 3 days, and lost 50% of the initial activity at 50 on the third day while 100% of the activity was lost on the 1st day at 60°C . The stability of rice malt amylase increased in the presence of CaCl_2 . At the optimized conditions, the malt amylase activity showed zero order kinetics for 25 min. The K_m and V_{max} of the malt amylase were 4.5 g l^{-1} and 127.78 Units respectively.

UTILIZATION OF DISTILLERY SPENT WASH AS NITROGEN SOURCE FOR ALCOHOL PRODUCTION AT 40°C

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During toddy distillation waste effluent from the still is known as distillery spent wash or stillage. Since distilleries produce large volumes of spent wash with high pollution potential, uncontrolled disposal of the spent wash is environmentally detrimental. Hence the feasibility of using spent wash for the production of alcohol was evaluated. The alcohol production with different concentrations (100, 150 and 200 g l⁻¹) of glucose was studied in spent wash and pre defined peptone Yeast Extract Nutrient (PYN) medium (g l⁻¹ peptone, 3.5; yeast extract, 3.0; KH₂PO₄, 2; (NH₄)₂SO₄, 1.0 and MgSO₄·7H₂O, 1.0). In all the experiments the inoculum was prepared in PYN medium at pH 4.5 containing 100 g l⁻¹ glucose in an orbital shaker (100 rpm) at 37°C and 18h old 10% (v/v) inoculum was pitched into the fresh media. Prior to sterilization, the pH of all the fermentation media was adjusted to 4.5. The fermentation was carried out at 40°C using the novel thermotolerent yeast developed in this laboratory. Complete utilization of glucose and 90% alcohol production efficiency were observed in 100 g l⁻¹ glucose supplemented spent wash and PYN media at 24 h. PYN medium with 150 g l⁻¹ glucose yielded 90% alcohol production efficiency with no residual sugar. Where as in 200 g l⁻¹ glucose supplemented PYN medium incomplete glucose utilization (2.0 g l⁻¹ residual sugar) with 78 g l⁻¹ alcohol production (production efficiency 78%) at 48 h was observed. In 150 and 200 g l⁻¹ glucose supplemented spent wash 23 and 60 g l⁻¹ residual glucose was found with 55 and 62 g l⁻¹ alcohol production respectively. When the composition of PYN medium was doubled, complete utilization of glucose and 90 g l⁻¹ alcohol production was observed. In order to make complete utilization of 200 g l⁻¹ glucose in spent wash medium, pre-treated spent was or spent was supplemented with different nitrogen sources were considered. Different amounts of yeast extracts (g l⁻¹, 5.0, 10.0, 15.0 and 20.0) were added to spent wash. Complete utilization of glucose was observed with minimum of 10 g l⁻¹ yeast extract supplemented spent wash. The alcohol production efficiency was 90%. Then it was decided to use other nitrogen sources such as peptone, soy powder and (NH₄)₂SO₄ having elemental nitrogen equivalence to 10.0 g l⁻¹ yeast extract. At the same time Neutrased (150,000 AU per 1000 ml spent wash, at pH 6.5, 45°C, 100 rpm for 6 h) spent wash also used with 200 g l⁻¹ glucose. After 48 h, peptone and (NH₄)₂SO₄ supplemented spent wash and Neutrased treated spent wash showed 90% alcohol production efficiency. Untreated and soy powder supplemented spent wash produced 65 and 72 g l⁻¹ alcohol respectively (and alcohol producing efficiency was 65 and 72% respectively) with 60 and 30 g l⁻¹ residual sugar.

LARGE SCALE FERMENTATION OF PALMYRAH MOLASSES BY A NOVEL PROCESS

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High gravity molasses (60 Brix) was diluted to 20 Brix with tap water and supplemented with 10.0 g l⁻¹ (NH₄)₂SO₄ (Control). In another set up, molasses (60 Brix) was made to 20 Brix with tap water and spent wash (effluent from the distillation column) in 1: 1 ratio and (NH₄)₂SO₄ was not added (Test). The spent wash has 1.1g l⁻¹ reducing sugar and 0.76 g l⁻¹ total amino acids with pH 3.5. Inoculum development was carried out by adding toddy sediment from 5 bottles of toddy (24h old) to 10 l molasses (10 Brix) and stirred continuously. After 18h this was transferred to 100 l fresh medium and stirred and finally 1000 l inoculum was developed. The test and control media in 5000 l fermentation wort were separately inoculated with the inoculum (10%, v/v). Mixing was facilitated by recirculating via pumps. The initial cell density was 2 x 10⁷ cells ml⁻¹. After 24 h fermentation 40 g l⁻¹ alcohol was produced. At 36 h the fermentation rate started to decrease rapidly and the temperature of the wort was 42°C. At this stage the wort was examined for yeast viability and only 10% viable cells were found. The viable yeast cells were selected. The above wort was left as such for observation and the fermentation has restarted after 48 h. After 72 h (from the commencement of the experiment) 70 g l⁻¹ alcohol was produced. The efficiency of alcohol yield was 70%. In another large scale fermentation trial the selected yeast strains were used as inoculum. The molasses (60 Brix) was diluted with spent wash and tap water in 1:1 ratio to 20 Brix. In this trial steady rate of fermentation was observed and at 65h 80 g l⁻¹ alcohol was produced with 80% efficiency. At this juncture the need for a thermotolerant yeast strain was realized and attempts were made to isolate a thermotolerant yeast strain.

TAMIL TRANSLITERATOR - A GRAPHICAL INTERFACE TO MICROSOFT WINDOWS - BASED WORD-PROCESSORS IN TAMIL

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The evolution of windows-based word processors and the availability of variety of Tamil fonts, make preparing Tamil documents on these word-processors possible. Nevertheless, a hesitance in typing Tamil among many students, research fellows and staff is evident. The reason, we have found, is that they are not very familiar with the existing layouts of Tamil keyboards. It would be easy for one to forget after a slack even if s/he becomes familiar with the keyboard after a consistent use. It is also found from many users that it would be easier to type a word in Tamil using English alphabet for its sound as, for example, we write Tamil names in English. This is a sort of English-to-Tamil transliteration. With this background in mind, a graphical interface is created in an easy-to-use style, which takes the Tamil text typed in English alphabet and produces the appropriate text in Tamil. This interface is, thus, referred henceforth as *Tamil-Transliterator*. This Tamil Transliterator is written in Visual Basic and can be run from within the word-processors with the use of macros. Visual Basic is very powerful, yet an easy to use windows-based language; the *Microsoft* has chosen this language for writing macros for *Microsoft Word*, *Microsoft Access* etc., as it has many useful features of a programming language. Though the work of this Tamil-Transliterator is not language dependent, Visual Basic is chosen for speedy implementation of the system. This system of Tamil-Transliterator adds power to the existing facilities of word-processors such as *Microsoft Word*. This transliterates the text typed in English and produces the text in Tamil. This transliteration is based on the usual convention of writing Tamils' names in English alphabet, but of course, with the awareness of the necessity of distinguishing the long syllables from short syllables and of distinguishing one from the other among the sound-like letters such as ட, ண & ண. The problem of conflicts such as this one are solved by adopting an easy-to-remember convention. The successfulness of our system is that the convention of phonetic-spelling adopted in this system does incorporate with the guessing of spellings even by a naive student, for words in variety of disciplines from Theology, Literature, Politics to Science. Moreover, this Transliterator provides flexibility for many words and blending of words giving a way not to be strict to the convention adopted, when the spelling by the convention may look unnatural to the user. Another useful and desirable feature of this system is the provision of on-line help: there is no need to remember anything about the convention; a mouse click on the help-menu would remind the user the convention for distinction with suitable examples. Also, one can use the text-editing facilities found in word-processors such as *Microsoft Word*. This work is a mile stone in the way of building transliteration-type word processors that would make use of all the facilities which the current word-processors can provide. It is definite that the transliteration type word-processors will become popular among many users, who are not familiar with Tamil keyboards. In this line, this system which adds the power to the existing word-processor to type in Tamil by transliteration, will be very useful and many users find it easy to use with no difficulty in guessing the spellings.

A GLOSSARY MANAGEMENT SYSTEM

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Computer literacy becomes essential for everyone in this computerised world. To promote computer literacy in Tamil is also essential as learning in mother tongue is advocated by many scholars. In view of this, a computer glossary has been prepared by the University of Jaffna, which gives Tamil words for technical terms in Computer Science. It would be very much helpful if the glossary is computerised with provision for easy handling. With this motivation a database system is created with spectacular graphical and user-friendly interface for glossary management. This system is written in Visual Basic and provides many database handling facilities in an easy-to-use way. Computer technical words along with their Tamil equivalents can be viewed, new words can be added, searched can be done for a given technical word for its Tamil equivalent. Also, deletion and changes can be done, whenever necessary. All these can be performed in an effortless way with a click of mouse button, and strikes of a few keys. The user is also provided with audio instruction in Tamil to guide him/her for handling of the system. This adds more power to the system for the user with less computer handling knowledge. It is unique in its aim and is successful on its use.

HEALTH FOR ALL BY THE YEAR 2000 : CAN JAFFNA MEET THE TARGET?

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Since the late 1970's the 'Primary Health Care (PHC)' approach in order to deliver 'Health For All by the year 2000 (HFA / 2000)' has been vogue in all the under developed countries of the World. Nearly all developed and under-developed countries endorsed the proposals set out by the World Health Organization (WHO) at its conference in Alma Ata in 1978. Sri Lanka was one of the signatories of the Alma Ata charter and has since the signing, been in the forefront of the movement. The WHO charter does not expect to make everyone healthy by the year 2000, but rather to make the pre-requisites for health available to all communities and regions. The purpose of this communication is to see whether the Jaffna region can reach the goals of WHO.

The social, cultural, political and economic status of the people of Jaffna have been deteriorated for the last two decades specifically after the Alma Ata charter was declared, due to military battles between armed organizations and the government troops of India and Sri Lanka. There were frequent displacements of families and villages and even mass exodus from Valikamam in 1995. Hence the usual health care system was disturbed and disorganised in the Jaffna region. Preliminary investigations conducted in 1998 at all the Divisional secretariat levels and 60 selected Grama servagar divisional levels in the peninsula to conduct 'Jaffna Socio-Economic Health Survey - 1999' reveals that, even if the target of Alma Ata charter cause positive effects among the natives of Sri Lanka in common, the people of Jaffna will not be content in this response since the objectives are remote as the living conditions of them are concerned. The above indication has been further strengthened when the pilot study of 'Jaffna Socio-Economic Health Study - 1999' was conducted with ten selected typical Jaffna families. Direct and indirect investigation methods were applied and the results supported to conclude the following. The goals of WHO depends not on the restoration of peace and health services, but primarily on modifying social institutions and refining the behaviors of individuals and groups. The primary barriers to achieve 'Health For All' are not physical or biological, but are interpersonal and socio-economic behaviors.

Related to this review, the following hypotheses are proposed;

1. Every human morbidity or disorder owes its prevalence, in whole or in part, to Socio-cultural- economic processes.
2. All social and behavioral processes can potentially be changed. The economic activities be reorganized or restructured.
3. Successful interventions through quantitative research to achieve social, economic and behavioral changes can reduce substantially the burden of morbidity, disability and hence premature death.

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