Journal of Energy Research and Environmental Technology (JERET)
Print ISSN: 2394-1561; Online ISSN: 2394-157X; Volume 2, Number 5; April-June, 2015; pp. 389-394

http://www.krishisanskriti.org/jeret.html

THE DYNAMICS OF ENERGY-ECOLOGY-ECONOMY: INDIAN FARMING AT CROSS-ROAD

S.K. Acharya[1], Sarafat Shaik[2], K. Mondal[3] and L. Das[4]

[1,2,3,4]*Department of Agricultural Extension, Dept. of Meteorology and Agricultural Physics*
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal
E-mail: [1]acharya09@sankar@gmail.com

Abstract—*The transformation of Indian farming stands at a crossroad, a systemic conflict between ecology and economy, and thereafter, amongst ecology, economy and energy. The grim absence of energy auditing in Indian farms has led the entire agro-ecology to a kind of energy entropy and chaotic metabolism. The unabated emission of energy from soil ecology will have a derelict effect on the mineralization process, capillary up-flow of soil moisture, germination of seeds, thermal support during critical growth phase and the insreaed propensity of soil born disease. the The sociology of energy consumption and generation, trapping and utilization, has got unique features that again can be configured as the farm metabolism as well as energy ecology in farm management. Most of the Indian farms, as few researches start evincing the fact, are suffering from moderate to high energy imbalances leading to energy entropy in farm and in farmers psyche. The farmers are from motivational entropy. The present study has incorporated the variables; size of holding, cropping intensity, family size, irrigation status, market orientation, expenditure allotment, economic motivation, consumption of electricity consumption to estimate the level of energy use status in the operating holdings of the farmers. The expenditure allotment and family size are found to have dominant impact on crop energy balances of the operating farms. The irrigation status has been found to generate divergent impact on energy balances.*

Keywords : *Energy balance, entropy, family size, market interaction, economic motivation.*

1. INTRODUCTION

The study of social ecology has gained a new momentum after social system theory came into operationalization. Extension is basically a science of knowledge system where in continuous and evolutionary interactions are occurring between knowledge and "social space". In this complex system the other components are (a) adoption and adoption period, (b) rejection, (c) Discontinuance, (d) reinvention crop and crop enterprises, (e) market and market intelligence, (f) meteorological components and cognate biological components. All these components are inextricably interacting with each other to ultimately characterize the journey of knowledge into social space. The transformation of agriculture and mellifluent, is the common nature for the new age agriculture. There is a clear showing from per hectare biological production to per hectare value generation with ecological pursuits and dimensions.

Farm energy metabolism basically estimate the dynamic of energy exchange between natural ecology and social ecology, as on date, we are use to perceived of yield in terms of biological productivity expressed through quintal of wheat production per hector. Seldom think in terms of volume of energy that we have yielded or trapped from the unit volume of farms. When the entire input are assure, we are not enough sure whether we can trapped the energy efficiently, in case any farm start losing its energy balances, the factor of production must suffer. It is a local oratory that the soil is cool, it means the energy emission from the soil basically farm soil, then its trapped energy from the atmosphere in the form of photosynthesis, in addition to it the unscientific tillage operation are also responsible for energy prodigal farming.

Day will come when germination of seed will very difficult become the downfall of latent soil energy, so a goner of extension science has to go a long way making this small and fragmented farms energy saving as well as enough productive to ensure food security.

Social ecology through its integrative and orchestration function can rationalize the expenditure after agriculture in the form of-

i. Application of agro-chemicals like fertilizers, pesticidesii. Handling of factor production with higher proficiency in terms of economic health iii. Generation of values in terms of calorie values, quality contents like proteins, minerals and therapeutics and making the volume of food production affordable and accessible to people of marginal sections.

The model on energy in social ecology has got three basic considerations –

1. Flow of energy from one small niche and in between can be called social metabolism.

2. The flow of capital into this system of entrepreneurship intensity of rotation to ultimately characterize enterprise product and outcome.

3. Conservation of energy through considering the renewability level of different energy forms entering the system.

The energy consumption pattern in India, especially in the agro-ecosystem, followed by small and marginal farm holdings, around 85% of total 130 million farm families in India, generating 259 million tonnes of food grain that include a record production of 106 million tonnes of rice, 95 million tonnes of wheat, 22 million tonnes of maize,

17 million tonnes of pulses, about 30 million tonnes of oilseeds, 210 million tonnes of horticultural production, 180 million tonnes of milk and 8.7 million tonnes of fish (2011-12), has got tremendous implication and need to be added against total volume of energy consumed is in a positive balance or poised with a negative balance either. With this background the present study has selected the topic "FARM ENERGY METABOLISM; AND ESTIMATION OF PRODUCTIVITY EQUIVALENCE AND ECOLOGICAL PERFORMANCE

2. OBJECTIVES

1. To develop and operationalize the concept of rural development and energy metabolism.
2. To study the farm energy metabolism, as a composite consequent variable, against a set of exogenous causal variables, consisting of socio economic, techno managerial and ecological characters.
3. To study the intra and inter level of relationship and interaction in order to estimate the farm energy metabolism, that has been contributed by a set of exogenous and causal variable.
4. To generate a kind of operational model for creating micro level farm energy policy towards achieving a sustainable rural development

The trend of global research on farm energy management: A structural depiction

Source	Year	Author	Key Points
Energy savings in agricultural machinery and mechanization, Elsevier Science Publishing Co. New York, USA	1988	Pellizzi, G, Cavalchini, AG, Lazzari, M.	In this paper, a framework to assess the operational energy inputs of various production systems and the relative performance of a grower within an adopted system is developed. This paper shows the usage of energy of cotton production into six broadly distinct processes, including fallow, planting, in-crop, irrigation, harvesting and post harvest.
Handbook of energy for world agriculture. Elsevier Science Publications Ltd, London	1990	Stout, BA	This is include use fertilizer, fertilizer and nitrogen fixation, policy of fertilizer and fertilizer transportation and also described energy for the water supply, use of energy in irrigation and potential energy saving in irrigation as well as mechanization of agricultural production
Energy in agriculture. Conservation Farming	1994	Tullberg, J, and Wylie,P.	This book presents a scoping study of opportunities to enhance energy efficiency and
Information Centre, Dalby, Queensland, Australia;			Minimise GHG emissions in Queensland's intensive agricultural sector with aims of -Review and assess available tools and technologies for conducting on-farm operational energy assessments/audits, Assess current practices in terms of energy efficiency, Identify opportunities to reduce operational energy inputs and impacts on greenhouse gas emissions

On farm energy use pattern in different cropping systems in Haryana, India, University of Flensburg, Germany, 2002	2002	Canakci, M Akinci, I	This research attempts to investigate the energy use patterns inGreenhouse vegetable production, to determine the energy output–input ratio and their relationships and introduced
Potential energy efficiency savings in the agriculture sector, The American Council for an Energy- Efficient Economy, Washington, D.C	2005	Brown, E, and Elliot, RN	The purpose of this paper is to review extant programs promoting energy efficiency in the agriculture sector and identification of national wide programs , determining the motivation of the

			program, obtaining a program description and evaluation program impact and success formal or non formal
Comparative Energy and Greenhouse Gas Emissions of New Zealand's and the UK's Dairy Industry	2007	Saunders, C. Barber, A.	This report compared the energy used and CO2 emissions between NZ and UK Dairy production. It has described that the UK uses twice as much energy per tonne of milk solids produced than NZ, , even including the energy associated with transport from NZ to the UK.
Farm Power and Machinery Management- 10th edition	2008	Hunt, D.	This book presents the optimization of the equipments phases of agricultural production which concerned with the efficient selection, operation, repair and maintenance, and replacement of machinery. The main aims of this books was to analyse the factors that comprise machinery management, to explain the function of various

			machines and mechanism as they affect economic operation.
Optimality Analysis of Energy- Performance Trade-o for Server Farm Management- Elsevier	2010	Gandhia, A. Guptaa, V. Baltera, M.H. Kozuch, M.A.	In this paper focused on the popular metric of energy response time product to capture the energy performance tradeoff and present the first theoretical result on the optimality of server farm management policies. It also discussed a pattern of stationary demand and have proved that there exists a very small, natural class of policies that always contains the optimal for a single server as well as a near optimal policy for multi server system.
Energy use pattern in vegetable production under Fadama in north central Nigeria	2011	Ibrahim, H. Y.	The aim of this paper was to examine the energy use pattern, energy use efficiency and energy productivity for Onion, Tomato, Sweet and Hot Pepper production under Fadama

3. METHODOLOGY

3.1 Sampling Design

Purposive as well as simple random sampling techniques were adopted for the study. For selection of state, district, block and gram panchayat purposive sampling techniques was adopted because the area was ideal for climate change study, convenient for researcher and having the infrastructural facilities and in case of selection of villages and respondents simple random sampling technique was taken up.

4. RESULT AND DISCUSSION

Table 1: Coefficient of correlation (r) between total crop energy balance (y1) and 23 independent variables(x1-x23)

Variables	r value	Remarks
Age(x1)	0.1074	
Education(x2)	-0.2023	
Family size(x3)	0.0748	
Male female ratio(x4)	-0.0371	
Occupation(x5)	-0.0999	
Cropping intensity(x6)	-0.0598	
Farm size (x7)	-0.1699	
Homestead land(x8)	-0.1202	
Expenditure allotment(x9)	0.1341	
% of farming expenditure(x10)	0.3163	*
Total income(x11)	0.1170	
Irrigation index(x12)	-0.1870	
Economic motivation(x13)	-0.0784	
Market orientation(x14)	-0.0437	
Labour engaged(x15)	-0.0106	
Average labour engaged per operation(x16)	0.0629	
Electricity consumption(x17)	0.0821	
Energy consumption per capita(x18)	0.0597	
Diesel consumption(x19)	0.2156	
Consumption of LPG(x20)	0.0055	
Consumption of kerosene(x21)	-0.0737	
Media responsiveness(x22)	0.0797	
Decision matrix(x23)	0.1548	

r>0.274 *(5% level of significance)

r>0.356**(1% level of significance)

Revelation:- The higher the farming expenditure, the higher has been the application of energy intensive input. So, total crop energy here has been found to have strong relegation to farming expenditure. A cost intensive farm has also been an energy intensive farm as well.

Table 2: Coefficient of correlation (r) between total crop energy output (y2) and 23 independent variables(x1-x23)

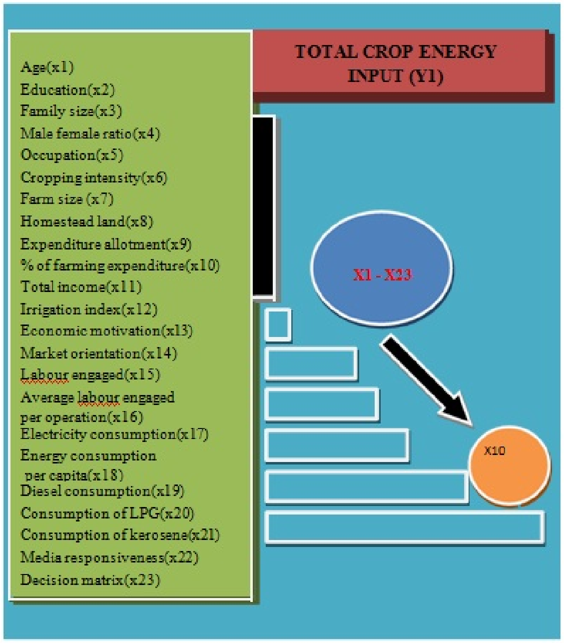
Variables	r value	remarks
Age(x1)	-0.0024	
Education(x2)	-0.0101	
Family size(x3)	-0.1623	
Male female ratio(x4)	-0.1690	
Occupation(x5)	-0.1185	
Cropping intensity(x6)	-0.2871	
Farm size (x7)	-0.1691	
Homestead land(x8)	-0.1404	
Expenditure allotment(x9)	0.7856	**
% of farming expenditure(x10)	0.3820	**
Total income(x11)	0.0592	
Irrigation index(x12)	-0.2544	
Economic motivation(x13)	0.2127	
Market orientation(x14)	-0.1588	
Labour engaged(x15)	-0.1091	
Average labour engaged per operation(x16)	-0.0739	
Electricity consumption(x17)	0.0994	
Energy consumption per capita(x18)	0.2092	
Diesel consumption(x19)	-0.1200	
Consumption of LPG(x20)	-0.2114	
Consumption of kerosene(x21)	-0.0897	
Media responsiveness(x22)	-0.1237	
Decision matrix(x23)	-0.0015	

r>0.356**(1% level of significance

r>0.274*(5% level of significance)

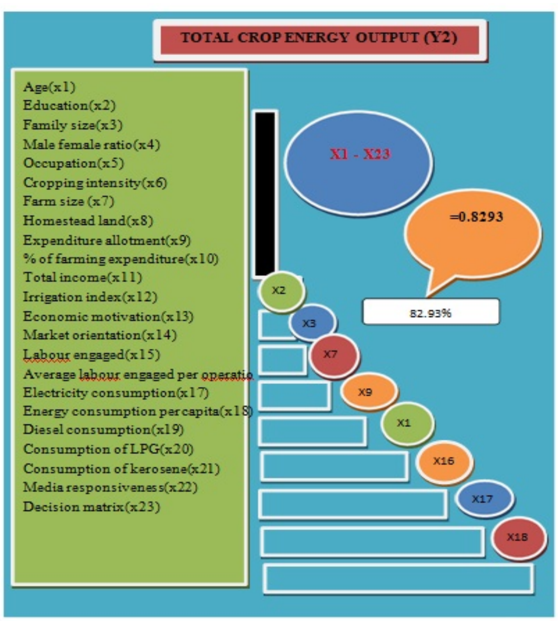
Revelation: - Expenditure allotment is an important determinant to decide on what enterprise and with what proportion; the expenditure will be incurred by the farmer. The higher the farming expenditure, the higher has been the application of energy intensive input. So, total crop energy here has been found to have strong relation to farming expenditure. Hence, a cost intensive farm has also been an energy intensive farm as well

Regression Analysis (Step down): Screening of variables having significant efficacy in impacting on Crop Energy Input (y1)



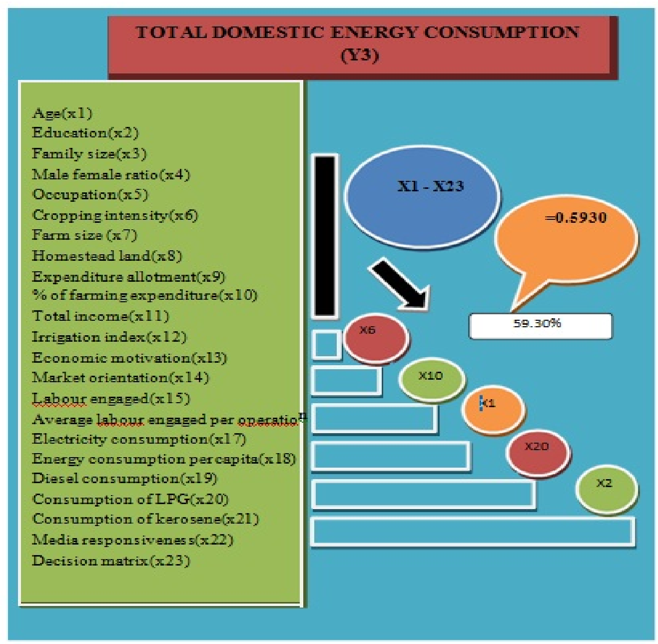
Revelation: The step down regression analysis presents that at the last step of the variable per cent of farming expenditure(x10), and has contributed 15 per cent to crop energy input. The sources of energy are linearly related to family requirement which again is impacted by farming expenditure. Only per cent of farming expenditure(x10) has been retained at the last stage of Step-down Regression Analysis which has contributed 15.00 percent to the total R^2 value.

Regression Analysis (Step down): Screening of variables having significant efficacy in impacting on Crop Energy Input (y2)



Revelation: The step down regression presents that eight prominent variables have contributed 82.93% to Total Crop Energy Output (y2). Education makes farmer aware of the different inputs used for farms, crops as well as home so that the output of farms, crops as well as, the health and hygiene of family members maintains an equilibrium with the ecosystem, energy consumption per capita(x18), electricity consumption(x17), average labour engaged per operation(x16), age(x1), expenditure allotment(x9), farm size4(x7), family size(x3) and Education(x2) have been retained at the following stage of Step-down Regression Analysis which has got cumulative contribution of 82.93 percent to the total R^2 value, i.e, to say that these variables deserve to earn a special attention while we intend to make a serious intervention in the domain of Total Crop energy Output.

Regression Analysis (Step down): Screening of variables having significant efficacy in impacting on Crop Energy Input (y3)

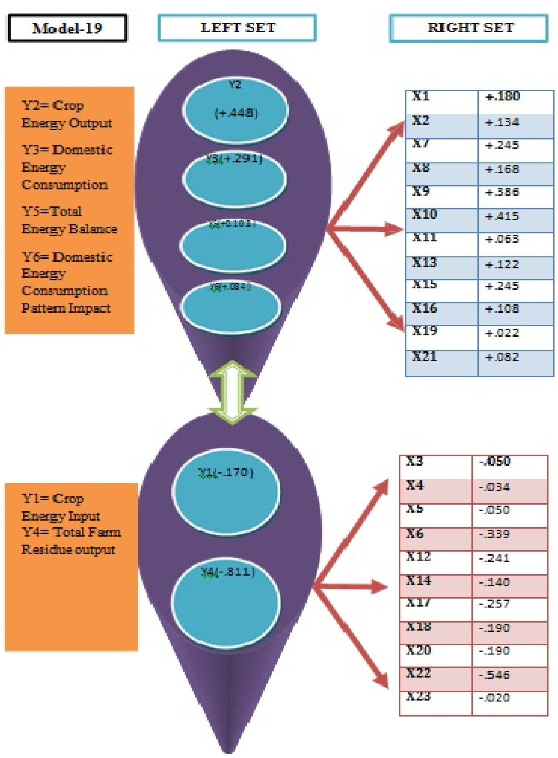


Revelation: These variables have been retained at the following stage of Step-down

Regression Analysis which has got solitary contribution of 59.30 percent to the tota R^2 value, i.e, to say that these variables deserves to earn a special attention while we intend to make a serious intervention in the domain of Total Domestic Energy Consumption.

5. CANONICAL COVARIATE ANALYSIS:

Two sets of variables (Y,X), have under gone canonical covariate analysis and the estimation of cross loading has been carried out. It has been found that the left set of variables (y) , y2, y3, y5, and y6, have moved together in the same direction. This four variables together have selected the following right set of variable viz; Age(x1), Education(x2), Farm size(x7), Homestead land(x8), Expenditure allotment(x9), Per cent of farming expenditure(x10), Total income(x11), Economic motivation(x13), Labour engaged(x15),Average labour engaged per operation(16), Diesel consumption(x19) and Consumption of kerosene(21) etc. And this indicates the crop energy balances y2, y3, y5, and y6 are strongly clung to each other and together they have selected the set of causal variables to have their close interaction. Same as it has been found that it is from the left set of variable (y) , Y1 and Y4, have moved together in the same direction. This two variables together have selected the following right set of variable viz; family size(x3), male female ratio(x4), Occupation(x5), Cropping intensity(x6), Irrigation index(x12), Market orientation(x14), Electricity consumption(x17), Energy consumption per capita(x18), Consumption of LPG(x20), Media Responsiveness(x22) and Decision matrix(x23) etc. This indicates that the crop energy balances y1 and total residue output y4 are strongly clung to each other and together they have selected for their close interaction, the set of exogenous variables from the right set.Canonical covariate analysis here has clearly depicted those y variables have got a stragelic and clandestine combination to organize this entire cause-effect relationship.



6. CONCLUSION

The extension research of farm energy metabolism is extremely nascent; so, it is very difficult to identify and estimate the interaction of befitting variables in any given farm ecology. The variable interactions are very complex it encompasses a wide range of factor to be configured in a single model.

Present empirical study depicts that the energy metabolism in a given farm ecology is contributed all by a set of socio-economic, farm resource and agri-managerial variables. Starting from the expenditure allocation down to electricity consumption, for example, have become important predictors for this farm energy metabolism.

The extension policies must aim at creating a new competency in making the farms energy efficient and this can be done by creating awareness and imparting energy education, transforming the conventional energy intensive approach in ecologically responsive farm operation

All kind of transformation has got both process and product components, so the usher the farm with efficient energy metabolism must have to have better competency, effective models and appropriate analytical methodology. A series of newly bred variables can help in creating a new format for interacting and factor of production ultimately leading to a energy efficient farm and effective farm management with conserving and recycling of energy resources.

BIBLIOGRAPHY

[1] Stout, B.A(1990). Measurement of agricultural field location using microwave frequency triangulation. *Journal of Computers and Electronics in Agriculture*. 4(3): 2009-223

[2] *Tulberg, J and Wylie, P.J(1995).* Partial equilibrium estimates of manufacturing trade creation and diversion due to NAFTA. *Journal of Economics and Finance*. 6(1): 65-84

[3] Canakci, M and Akinic, I (2002). On farm energy use pattern in different cropping systems in Haryana. *Journal of Agriculture Science*. 66(4): 519-523

[4] Hunt, D (2008). Farm Power and Machinery Management- 10th edition. *Journal of Agriculture Science.* Farm Power and Machinery Management- 10th edition 2001 pp. 368

[5] Ibrahim, H. Y. (2011). Energy use pattern in vegetable production under Fadama in north central Nigeria. *Journal of Tropical and Subtropical Agroecosystems*, 14 (2011): 1019-1024

[6] Gandhia, A.Guptaa, V.Baltera, M.H. Kozuch, M.A. Optimality Analysis of Energy- Performance Trade-o for Server Farm Management. *Journal of performance Evaluation*. 67(11): 1155-1171

[7] Pellizzi, G, Coral chini, AG and Lazzari, M (1988). Energy savings in agricultural machinery and mechanization. *Energy savings in agricultural machinery and mechanization. 1988pp.143pp.*

[8] Brown, E and Elliot, RN (2005). Potential energy efficiency savings in the agriculture sector. American council of an Energy Efficiency Saving in Agriculture sector.

[9] Saunders, C and Barbar, A(2007). Comparative energy and greenhouse gas emissions of New Zealand's and the UK's dairy industry. Research report (Lincoln University (Canterbury, N.Z.). Agribusiness and Economics Research Unit; no. 297,