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Focus: Energy and Environment

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Energy Integration Problem in Cogeneration Plant

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Public–Private Partnerships and Electronic Toll Collection

The Association between Price Reaction and Information Environment

Understanding Product Flow and Information Flow Dimensions

Impact of Global Financial Crisis on Developing Economies

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Focus

Energy Conservation through Improved Maintenance of Plant and Machinery

S.K. CHAKRAVORTY

The corporate monthly energy bill has, until recently, rarely been viewed by the maintenance department of a company. Due to globalization of economy and the consequent need for the development of a competitive edge to survive in the global market, the corporations finally recognize maintenance as an integral part of the production process. In order to maximize overall equipment effectiveness (OEE), the individual roles of each department has lead to teamwork and new cooperative initiatives. One of these initiatives allows the maintenance department to share the responsibility and gain recognition for its energy reduction efforts. This article discusses about nine important areas where energy conservation can be achieved by the maintenance function of an organization.

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Friction can be classified as the maintenance department's single largest enemy. Friction causes heat which in turn causes wear, which directly impacts energy consumption levels; the more that friction is present in a piece of machinery, the greater the energy requirement to operate the machine. Therefore major responsibility of any maintenance department is to ensure that heating, cooling, and generated power systems (compressed air and steam) are operating at a level no less than the original minimal design efficiency level, and to ensure that losses related to ineffectiveness and energy waste are under the direct control of maintenance. In this situation, equipment maintenance retains a direct link to energy use effectiveness and is viewed as a major player in the effective reduction of energy waste. Understanding the direct relationship between maintenance and energy effectiveness is essential when establishing energy reduction initiatives.

Maintenance

Maintenance originates from the word "maintain" meaning "to keep in an existing state." Equipment and facilities must continue to exist and operate at acceptable levels, otherwise, they risk becoming obsolete and non-competitive. Maintenance is a crucial component of any industry, institution, or facility. Maintenance is the component that allows the industry, institution, or facility to service, or produce, an end product in the manner, and at a level, for which its process was designed. Maintenance should be viewed as an investment in the corporate well-being and be able to sustain a defined level of quality assurance. For increasing productivity, the optimum maintenance strategy should be selected from preventive, predictive, productive, planned, and proactive maintenance approaches.

Maintenance practices and energy consumption

Maintenance is a business concerned with and dedicated to evaluation, assessment, calibration, adjustment, repair, overhaul, and replacement of failed components in machinery, facilities, tools, and mechanical and electrical systems. The majority of equipment consumes a basic level of energy, regardless of its output; this means that specific consumption is a function of load. High efficiency is achieved through three key elements: *(i)* good energy-efficient design (which is difficult to change without major rework); *(ii)* effective maintenance; and *(iii)* good load factor (that is, optimum use of machinery in energy-management terms), Machinery that consumes energy independent of load condition (for example, when idling) requires the production planning department to address idle time reduction—either through streamlined planning or automated controls. Studies performed by Research Institute for Energy Economics concluded that over 30 percent of total energy consumed by machine tools in a single shift was due to idling during operation break times and non-productive times. Mechanical and electrical equipment require sustained energy in order to produce work. For all moving equipment energy, input = workout + energy losses. Reduction of energy losses dictates the validity and importance of the maintenance function.

There are many areas that affect the industrial energy bill; by focusing on conserving energy in these key areas, maintenance is able to influence a positive change on the corporate electrical energy consumption bill. The nine areas that are very relevant because of their direct daily link to the maintenance function are viz. lubrication, compressed air systems, electrical connectivity, mechanical drive systems, waste heat and cooling recovery, housekeeping, preventive maintenance, lighting, and steam systems

Lubrication

Lubrication serves two main purposes: *(i)* to reduce the friction that occurs when the surfaces begin to move or slide over one another; and *(ii)* to cool the surfaces (reducing heat losses). Both of these actions help prevent wear and reduce frictional energy losses. It is estimated that upto 30% of consumed energy is exhausted in trying to overcome friction (Blanchard, Clifford, and Kent, 1987). Effective lubrication practices, therefore, provide significant opportunities to reduce energy losses. For minimizing energy consumption and increasing OEE, the following steps may be followed:

- Perform a lubrication-effectiveness review to determine areas of effectiveness and, more importantly, areas of opportunity.
- Determine lubrication requirements for all lubricated equipment.
- Replace grease nipples with engineered displacement delivery blocks wherever practical.
- When in doubt, refer to equipment manufacturer's guide for the correct lubricant or lubricant equivalent to use.
- Develop a clear policy for purchasing and lubricant storage by indicating how and where lubricants are to be used.
- Change out lubricants based on actual usage patterns rather than OEM generic recommendations. Use oil analysis to determine the appropriate changeout intervals.
- Investigate the use of premium and synthetic lubricants for optimum energy consumption.
- Perform an energy-use analysis before and after lubrication changes to determine the actual program savings.

Compressed Air Systems

Compressed air systems represent approximately 5 percent of industrial electrical energy use. In a typical two-shift manufacturing operation, the energy costs of running a new compressor will often surpass the initial compressor's purchase price within the first year of operation. 25% of consumed energy is wasted due to system inefficiency (Talbot, 1986). Improperly designed and improperly maintained systems reflect this inefficiency through: *(i)* decreased compressor performance; *(ii)* compressed air leakage; *(iii)* distribution system pressure drop.

Regardless of the system design, by using effective maintenance practices, existing energy costs can be significantly reduced. The following steps may be undertaken for minimizing energy consumption in compressed air systems:

- Perform a compressed air audit study to determine energy savings opportunities.
- Perform air leak checks as a regular part of a preventive/pre-directive maintenance program.

- Use a synthetic compressor lubricant when appropriate. It will reduce energy consumption and extend lubrication change-out interval time by up to five times.
- Ensure the compressed air system has a correctly sized dryer system.
- Limit the use of air blow off devices. If they must be used, use an engineered nozzle which will realize 40–90% savings when compared to a makeshift blow-off device.
- Use a timer device or solenoid-operated device to control blow-off air.
- Ensure compressed air filter checks and changes are a regular component of the preventive maintenance program.

Electrical Connectivity

Performing electrical connectivity testing is a large part of any electrical maintenance management strategy. Unnecessary repeated tightening of the same connection leads to over-tightening, which causes the conductor to fracture and ultimately produce an energy ground fault. A non-intrusive and effective maintenance approach to checking for loose connection involves the use of a predictive maintenance infrared (IR) non-contact measurement device—an IR thermographic camera or thermometer—to scan all of the connections so that only those that are out of specification (ground faults produce additional heat which the IR device detects) can be identified (Grover, 1993). Any defective connection can then be tightened to specification, usually to a predetermined level of torque using a torque driver. The same IR device can also be used in the same manner to check for unbalanced phases, loose connections (ground fault), poor insulation, degenerated fuses, worn brushes, broken or loose switch gear in electrical connection; ballast operations in lighting systems; overloading, worn brushes, bearing failures, etc., in motors; poor connections, broken insulators in power transmissions and windings problems in transformers eliminating electrical failures reducing electrical consumption.

Mechanical Drive Systems

Mechanical drive transmission systems transmit electrical energy from an electrical motive device to a driven device via mechanical devices, such as couplings, gears, belts, chains and cams, linkages, clutches, brakes, etc. Whenever a mechanical device is introduced between the developed energy source and the final work area, an efficiency drop occurs. Good design and efficient maintenance practices can effectively reduce energy costs required to overcome these inefficiencies. The major cause of inefficiency in a mechanical drive transmission system is poor or improper alignment. Laser alignment equipment manufacturers claim that improved alignment of shaft-coupled rotating equipment has been measured to produce electrical energy savings of upto 11% while increasing the longevity of the mechanical couplings, gears, bearings, etc., by upto eight times. The following steps may be taken for reducing energy consumption in mechanical drive systems (Power Transmission Distributors Association, 1993):

- Ensure belts and chains are tensioned properly at all times.
- Ensure brakes do not trail.
- Check gearbox lubricant to ensure it is the correct viscosity.
- When correcting soft foot condition, use only precision shim stock and measure shims before use.
- Implement vibration analysis, thermography and oil analysis for proactive maintenance of drive systems eliminating wastage of energy.

Waste Heat and Cooling Recovery

Heat recovery and cooling systems require engineering studies that are usually beyond the normal realm of general maintenance activities. However, more and more companies are charging their maintenance departments with the responsibility of handling the energy budget. The maintenance department must, therefore, be cognizant of these valuable energy saving opportunities. A good maintenance practice is one which introduces a heat recovery and cooling system when conditions warrant. There are many different methods and areas of opportunity for the recovery of waste heat in every facility and industry. Waste heat can be recirculated and used for space heating, hot air curtains, pre-heated process makeup air, and for heating process and potable water. Upto 94% of the heat equivalent of total electrical input can be recovered through an enclosed oil-cooled screw compressor arrangement (Bannister, 1999). Quite often manufacturers of compressed air systems offer heat exchangers for the

production of hot water. The following steps may be taken for conserving energy through waste heat and cooling recovery:

- Use an IR detector to check for effectiveness of heat exchangers.
- Use IR thermal imaging to check for insulation and refractory degradation.
- Once a heat recovery opportunity is identified, perform an engineering study and savings analysis to determine best methods for return on investment before the start up of any heat recovery project. Assistance in this area is available through the local utilities, consultants, and energy-savings companies.

Housekeeping

Housekeeping is a key component of any maintenance philosophy, for example, Reliability Centered Maintenance (RCM) or Total Productive Maintenance (TPM). Both RCM and TPM prescribe equipment cleanliness that facilitates maintenance and increase the production output efficiency. Dirty contactor tips cause improper contact between tips and results in high current draw. Dirty magnet faces cause relays to chatter. Dirt buildup on arc shields causes the shield to flash over, and render the arc shield useless. Dirty or clogged air vents cause electrical components to overheat. Dirty electrical cabinet filters cause reduced air circulation and increase the cabinet ambient temperature.

If dirt is allowed to build up on heat exchangers, reservoirs, motors, etc., it produces a "thermal blanket." Thermal blankets cause the lubricant temperature to rise, thus reducing viscosity, lubricant protection, and lubricant life. Thermal blankets on electrical motors can cause poor cooling, thus raising the temperature of the motor. When filters become clogged or contaminated, they restrict air flow. When air flow is restricted, the equipment has restricted cooling or process air, thereby making the equipment less efficient and more demanding of energy. The following steps may be taken for conserving energy through housekeeping:

- Introduce equipment cleaning as a regular part of maintenance inspections.
- Whenever possible, place air filtration media on outside of equipment so that the condition can be easily seen and changed as required.

Preventive Maintenance (PM)

The modern companies have realized that maintenance is the single largest controllable cost and that the facility's energy budget is not only affected by the maintenance process, but also belongs under the control of the maintenance department. The maintenance department will implement energy-saving initiatives and the maintenance department's budget will pay for those initiatives. When maintenance instructions are inadequate, the work performed can adversely affect quality, energy consumption, and machine efficiency. For example, a PM instruction saying, "check and tighten all connections," does not state the torque rating for the connection and therefore can require more work to be performed than is necessary. Over tightening will make the conductor work harden and eventually cause a ground fault. Overheating will occur and energy consumption will increase. Therefore the instruction should be to identify all loose connections with an IR temperature detection device and tighten loose connections to a torque rating of 8 psi. Another example of inadequate PM instruction may be: "Lubricate as necessary." With this type of instruction, the maintainer does not know how to lubricate, what lubricant to use, how much lubricant to use, and if lubrication is even necessary. Therefore, if the maintainer pumped grease into an oil cavity at 50 times the amount required, the interpretation would be as subjectively correct as not lubricating at all. Both choices could cause major damage to the equipment and increase energy requirements. To avoid this situation, a clear task description should be objectively written as "Lubricate bearing A, B, C, D and E with blue grease gun containing EP-2 xyz brand grease, 2 gun strokes = 2cc per bearing required at the end of each 8-hour shift." The following steps are necessary for conserving energy through better PM practice:

- Check present PM instruction sets for ambiguity.
- Ensure task definitions are concise, descriptive, and relevant.
- Whenever possible, number the steps involved, giving "if" and "then" options to facilitate the process.
- Refer to and note actual specifications within the PM task.
- Always produce feedback reports. For example, how well equipment performed as a result of the PM; energy usage prior to and post PM.

Industrial Lighting

There are two basic methods for approaching industrial lighting energy reduction: *(i)* change lighting type and/or fixtures, and *(ii)* lighting load reduction. High Intensity Discharge (HID) lights are upto 2.5 times more efficient than fluorescent lights. Fluorescent lights are 3 times more efficient than incandescent lights. Fluorescent fixtures can be made more efficient by installing a mirror-like retrofit reflector polished and angled to increase the light refraction more efficiently than a standard reflector. In places where existing light levels are low, reflectors can increase light levels by upto 15%. Therefore, where light levels are too high, lamps and ballasts can be removed from the fixture, thus reducing energy consumption by up to 50% while only decreasing lighting levels by 25% (Ontario Hydro., 1990). For lighting load reduction occupancy sensors, either infra red or ultrasonic motion detectors can be connected to the lighting circuit to conserve energy. When a person enters an area with these sensors, full lighting is restored; when the sensors detect no movement within the area after a certain time, the lighting is once again dimmed (in the case of HID lighting) or turned off completely. Occupancy sensors can reduce energy demands in excess of 35%. The following steps will ensure energy conservation through optimum industrial lighting:

- Clean light reflectors and lamps on a regular basis.
- Perform a lighting management study to determine exact lighting requirements and potential energy savings opportunities.
- Replace incandescent lamps with compact fluorescent lamps as lamps burn out; energy use is 80% less and the lamps lasts four times as long with only a one-year payback.

Steam Systems

The steam system requires adequate insulation or "lagging" to ensure minimal passive heat loss and to attain maximum efficiency. Breaks, or damage to insulation, allow heat to escape, which can force steam to condense unnecessarily. Correct operation of the automatic steam trap purge valves is crucial. Steam equipment manufacturers estimate that over 15% of all steam valves fail annually. Leaking steam traps are perhaps the largest area of system inefficiency. The maintenance department can influence steam system energy savings within three major areas: *(i)* leak detection and elimination; *(ii)* pipe insulation checks; and *(iii)* water treatment.

Steam leaks can be effectively checked by using an infra red thermal imaging system or an ultrasonic leak detector device. Pipe insulation is easily checked for external damage and can be checked for internal damage and wetness (wet insulation is ineffective and is usually evidence of a leak) by using an infrared thermal imaging system. Both damaged and wet insulation will show up as a local "hot spot" on the thermogram. A 10-foot length of un-insulated 4-inch steam pipe will waste approximately Rs 20,000 of steam per annum. The cost of 2-inch fiber-glass insulation with an aluminum jacket would cost only Rs 10,000, thereby giving a return on investment in about 6 months (Natural Resources Canada, 1995).

Fouling, or scaling, of heat exchange surfaces within the boiler will seriously inhibit the boiler's ability to heat the boiler water; this results in increased flue gas temperatures and energy requirements from the boiler. The boiler industry estimates that a 0.040 inch (1 mm) scale buildup on the internal boiler tubes will increase fuel consumption by 2%. The following activities are suggested for conserving energy through proper maintenance of steam systems.

- Perform an annual infra red scan on the entire steam system.
- Tag all steam traps with a "FAILS OPEN" or "FAILS CLOSED" indicator.
- Include water treatment as part of the PM program.
- Perform regular boiler cleaning and maintenance.

Conclusion

It may be concluded that equipment maintenance has a direct link to energy use effectiveness and is a major player in effective reduction of energy waste. The energy consumption can be reduced by proper lubrication of equipment; upkeep of compressed air systems, predictive, and corrective maintenance of electrical connectivity; maintaining proper alignment of mechanical drives; recovering waste heat from equipment and eliminating hot spots/patches; systematic PM system and housekeeping; selecting and maintaining lighting fixtures and eliminating leakages of oil, steam, compressed air, water, etc.

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Without inspiration the best powers of the mind remain dormant. There is a fuel in us which needs to be ignited with sparks.

—Johann Gottfried Von Herder

Energy Integration Problem in a Cogeneration Plant

AVIJIT NAYAK AND SHIVAJI BISWAS

The lashings of hurricanes and cyclones on different parts of world, huge rainfall deficiency in north India, melting of icebergs in north as well as south pole expose mankind to a big question—will our next generation get energy to live up to 60 years?

Leading climate experts have put forward a series of practical solutions to tackle climate change—all leading bodies like—Intergovernmental Panel on Climate Change (IPCC).

This is a case study of a coal-fired power station and one cogeneration unit situated in central India. The unit started its operation in 1958. Cogeneration plants having backpressure turbine and condensate recovery consume huge quantity of make water. As a result, in order to keep drum water quality within control, a blow down has to be given @ 7000 kg/hr at 70 kg/cm^2. This case study discusses a problem area where waste heat energy recovery due to the existing technology become unviable.

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Condensing turbine along with backpressure type of turbine is a common example for integrated steel plants. In these type of plants superheated steam is distributed to turbine stop valve through a common bus. Similarly, the feed water to boiler is also supplied through a common bus. The general plant design parameters are:

1. steam pressure at turbine stop valve = 60.618 kg/cm^{2}G
2. steam temperature at turbine stop valve= 482°C
3. Power generation capacity for condensing turbine = 30 MW
4. Power generation capacity for back pressure turbine = 13 MW
5. Bled steam pressure at 5th stage = 18 kg/cm^2, 8th stage = 10 kg/cm^2, 11th stage = 5.4 kg/cm^2, 13th = 3.23 kg/cm^2, 16th = 0.635 kg/cm^2
6. Extraction pressure (bled steam pressure from back pressure turbine) = 18 kg/cm^2, 8 kg/cm^2

Average plant parameters for 13MW backpressure turbine are as follows:

- Installed capacity = 13 MW
- Boiler capacity = 150 T/H
- Turbine: back pressure with single extraction
- Monthly unit generated = 8 MU
- PLF = 87.54%
- Boiler MCR loading = 102.24%
- Makeup water consumption = 12000 MT/month

- Steam export/month to different process areas: 18 kg/cm^2 = 48021 MT/month, 8 kg/cm^2 = 45136 MT/month
- Total steam export rate to different process areas = 130 T/h
- Condensate return: Nil
- Heat rate: 4302 kcal/kwh

Techno economics of using blow down water

It is proposed to use motive steam of 7970 kg/hr for the use of a thermocompressor. The flash steam at 6 kg/cm^2 will be partially used for "Deareator," which will reduce steam load. PRV at this place will reduce 6 kg/cm^2 steam to 3 kg/cm^2 to thermo compressor. The economics of one suggested option is presented as:

1. Available steam properties at 60 kg/cm^2: T = 482°C, H = 758.15 kcal/kg, T_{sat} = 275°C
2. Desired motive steam: Pr = 25 kg/cm^2.g, T_{sat} = 224.99°C, flow = 7970 kg/hr, Enthalpy = 669 kcal/kg
3. By heat balance desuperheating required = 88.85 kcal/kg
4. Amount of desuperheating water/kg of steam = 0.1327 kg/kg
5. Since flow of 25kg/cm^2 steam is specified as 7970 kg/hr, amount of water to be injected = 1058.02 kg/hr
6. Thus actual flow of 60 kg/cm^2 superheated steam = 6911.98 kg/hr
7. Estimation of work loss: The expected work loss on the basis of 6911 kg/hr and 60 kg/cm^2 at 82°C temperature will be 1218 kwh, this was calculated on the basis of prevailing heat rate as 4302 kcal/kwh, sale value of this energy @Rs 2.40/kwh will be Rs 2923/hr

Steam Cost

In most companies, the reported cost of steam is the average cost of generation at a particular production rate. The total operating cost—fuel, power, water, chemical additives, labor, maintenance, depreciation, interest overheads are divided by the total amount of steam produced. For steam used for power generation, fuel cost is the dominant cost. This is given by:

$$C_f = a_f \times (H_s - h_w)/\text{Efficiency of boiler}$$

where a_f = fuel cost, Rs/MKCal = 357.98, H_s = Enthalpy of steam in kcal/kg = 758.15, h_w = Enthalpy of boiler feed water in kcal/kg = 200, Efficiency of boiler = 0.8562. Computing data, C_f = Rs 233.36/MT

Total steam cost and fuel cost is related by this relationship:

$$C_g = C_f(1 + 0.3)$$

where 0.3 represents typical value of the sum of cost components, such as raw water supply cost, feed water treatment cost, feed water pumping power, combustion air fan, sewer charge for boiler blowdown, ash disposal cost, maintenance material, labor, etc.

Thus total steam cost will be 233.36 (1 + 0.3) or, Rs 303.368/MT

Expected cost of 7970kg/hr steam flow at 25 barg is Rs 2417/hr

Utilization of motive high pressure steam for thermocompressor application costs both, that is, wastes power generation potential and the usual steam cost. In nutshell, financial loss per hour will be 2923 + 2417 or Rs 5340 or Rs 467.801 lakh/annum (8760 hr/yr).

Benefit

Total AC load in Unit Control Rooms (UCBs) is 80 TR, replacement of present conventional vapor compression absorption chiller by absorption type will save power. The table that follows shows relative power drawl of two types:

Capacity	Vapor compression refrigeration system	Vapor absorption refrigeration system
50 TR	55 KW	1.5 KW
100 TR	110 KW	2.4 KW
500 TR	400 KW	7.75 KW
1000 TR	800 KW	11.25 KW

The expected differential power drawn for one 80TR VAR plant is 86.08 KW. Beside, steam at 3kg/cm^2 will reduce steam cost. As per a reputed manufacturer of VAR, the annual kwh savings @8760 hr will be 754060 kwh or Rs 18.09 lakh (@Rs 2.40/kwh).

The other benefit is that steam availability to 8 kg/sqcm header, as shown in figure, 9680 kg/hr steam at 8 kg/sqcm, after meeting VAR steam demand, will bring

additional financial benefit of Rs 257.246 lakh (9.680 MT/hrx 8760 hr/yrx Rs 303.368/Mt), so the overall benefit will be the addition of both (18.09 + 257.246) or Rs 275.246 lakh.

As per flash steam energy balance, total 2112 kg/hr steam at 3kg/sqcm will be available at flash vessel stop valve. There is a technical problem to use 8 kg/sqcm to the VAR system. That is why idea was abandoned.

Net benefit

Since superheated motive steam has to be used, the scheme is not economically viable.

What is the gap?

This case study brought a technological gap which exists for this type of cogeneration unit where, in the absence of proper energy recovery, technology 4.63 x 10^6 kcal/hr at 284°C is lost .

Conclusion

There is an urgent need of a viable solution for this type of situation where proper flashing technology will improve overall plant efficiency.

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Energy Efficiency in Thermal Utilities—Guide Book for National Certification Examination or Energy Managers and Energy Auditors, pp. 55–60.

Nothing will ever be attempted if all possible objections must first be overcome.

—Samuel Johnson

Focus

Sustainability under Settled and Shifting Cultivation in the Hill Agriculture of Assam

D.C. KALITA AND B.C. BHOWMICK

The present study was undertaken in the hill zone of Assam which comprises of Karbi Anglong and North Cacher Hill districts, carrying out both kinds of production systems—settled as well as shifting cultivation. A sample households was selected and an economic evaluation of the cultivation system was done, aimed at determining whether the output–input ratio was higher in case of shifting cultivation or settled cultivation. The result indicated a higher return in settled cultivation. While the food balance sheet under both showed cereals production to be satisfactory, except in Group-I farms, the oilseed production was found to be deficit in one of the groups but surplus in the remaining two groups of the sample. Fuelwood production showed a substantial surplus.

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The agricultural production systems in the hilly areas differ from the plough cultivation in the plain areas. On one side highly modern agricultural cultivation practices flourishes while on other side age-old agricultural practices dominates. Thus dualism in agriculture still persists in the hilly areas. This system of dualism determines the standard of living of people. Further, there are two distinct agricultural production systems in the hilly areas, viz., settled and shifting cultivation. The tribal people practice the shifting cultivation which is locally known as humming and this system is the first step of transition from hunting to food production system. Usually the settled cultivation is practiced in foothills and terraces on gentle slopes. The production behavior in both the systems is more or less similar as crop mixtures are grown in both the production systems. However, the productivity under settled cultivation is higher than that of shifting cultivation (Chauhan, 2001). This productivity difference leads to differences in livelihood standards of people. The productivity in these two production systems differs greatly and thereby causes a serious problem of food availability. Therefore, it is necessary as well as important to know the economics under both the production systems.

The global food security will be a cause of concern in the coming decades if environmental foundations for sustainable agriculture are not preserved. Assam is situated in the eastern Himalayan region between 24th to 28th 18'N latitude and 89'50'to 97'4'E longitudes. About 90% of the population of the state is rice eater. Assam has a population of 2.66 crores and recorded a decal growth rate of 18.85% (calendar 2001). Therefore, it is necessary to jump the current production to feed the population. The state had a deficit of 6.19 lakh food grains during 1992–93. If the forest resources continue to deplete at such a rate, the survival of future generation will be at a stake.

In this light the need of redoubling efforts in enhancing agricultural production and promoting agrarian prosperity needs no emphasis. To attain this goal promotion of sustainable agriculture is the only solution. Sustainable agriculture is that form of farming which produces sufficient food to meet the needs of the present generation without eroding the ecological assets and the productivity of the life supporting system of future generation (Thakur, 1995). The study of the system will provide a broad basis for developing farm plans which in turn help the farmer to utilize his resources optimally for achieving sustainability to ensure a minimum standard of living. In the light of the increasing population in the state of Assam, promotion of sustainable agriculture is the only solution to feed the people. Attainment of sustainability in terms of food and fuels without impairing the soil fertility status and distributing the minimum forest coverage is the main objective for developing plans for future. Keeping in view the above facts, the present study is an attempt to look into the economics of settled and shifting cultivation along with their sustainability in hill agriculture of Assam.

Methods and Materials

The present study was undertaken in the hill zone of Assam which comprises of Karbi Anglong and North Cacher Hill districts. Both the production systems of settled and shifting cultivation are followed in the zone. The study was based on primary data of 200 sample households out of which 100 sample households followed shifting cultivation and the rest 100 sample households followed settled cultivation. The sample households were selected by using multistage random sampling procedure and selected farmers were categorized into three size groups based on area under settled and shifting cultivation. The sample households were selected by using multistage random sampling procedure and selected farmers were categorized into three size groups based on area under settled and shifting cultivation using cumulative root frequency rule (Cochran, 1977). Data pertained to the year 1999–2000 and were collected from the sample households by interview method using structured schedules. The various crop mixtures and cropping sequences were first identified under shifting and settled cultivation, respectively. Then the cost and return of each crop mixture and cropping sequences under shifting and settled cultivation were done (Table 3, Table 4). The economic evaluation of settled and shifting cultivation was done mainly by estimating the output–input ratio along with the net return.

For measuring the sustainability under both the systems of settled and shifting cultivation, food balance sheet was prepared for cereals, oilseeds, and fuels based on the per adult per day requirement (Table 5, Table 6). The systems were to be considered as sustainable if there was no deficit in case of cereals, oilseeds, and fuels.

Table 1: Various cropping sequences

Cropping sequence	Group-I		Group-II		Group-III		All	
A. Upland:								
1. Ginger	4(10.53)	0.35(3.31)	3(9.38)	1.18(3.67)	5(16.67)	4.95(9.18)	12(12.00)	2.16(6.68)
2. Turmeric	3(7.89)	0.42(3.97)	4(12.50)	1.23(3.78)	3(10.00)	2.43(4.50)	10(10.00)	1.36(4.21)
3. Ahu rice-sesamum-mustard	5(13.16)	1.81(17.14)	2(6.25)	2.75(8.46)	2.(6.67)	3.33(6.17)	9.(9.00)	2.63(8.17)
4.Ahu rice-fallow-mustard	3(7.89)	0.29(2.75)	3(9.38)	2.15(6.62)	2(6.67)	2.30(4.26)	8(8.00)	1.58(4.87)
5.Fallow-sesamum-mustard	2(5.26)	0.67(6.34)	3(9.38)	1.40(4.31)	3(10.00)	1.36(2.52)	8(8.00)	1.14(3.57)
B.Medium land:								
6. Ahu rice-maize-fallow	2(5.26)	0.78(7.39)	3(9.38)	3.41(10.49)	2(6.67)	5.00(9.27)	7(7.00)	3.06(9.46)
7. Ahu rice-fallow-vegetables	4(10.53)	1.20(11.36)	3(9.38)	3.04(9.35)	2(6.67)	3.33(6.17)	9(9.00)	2.52(7.79)
8. Colocasia	3(7.89)	0.50(4.73)	3(9.38)	1.44(4.43)	2(6.67)	2.54(4.71)	8(8.00)	1.49(4.61)
C. Low land:								
9. Fallow-Sali rice-fallow	5(13.16)	1.57(14.87)	4(12.50)	5.60(17.23)	2(6.67)	5.65(10.47)	11(11.00)	4.27(13.21)
10.Ahu rice-Sali-fallow	7(18.42)	2.97(28.13)	4(12.50)	10.30(31.69)	7(23.33)	23.06(42.74)	18.(18.00)	12.11(37.46)
Total	38(100)	10.56(100)	32(100)	53.95(100)	30(100)	53.95(100)	100(100)	32.33(100)

Note: Figures in parentheses indicate percentages to total sample farmers and gross cropped area

Table 2: Identification of Crop Mixtures across Size Groups under Shifting Cultivation

Crop Mixtures	Name Crop Mixture	Group-I	Group-II	Group-III	All
Rice + maize + ginger + vegetables+ colocasia + marua	CM I	8 (25.00)	11 (27.50)	6 (21.43)	25 (25.00)
Rice + maize + ginger + vegetables + colocasia + pumpkin	CM II	9 (28.13)	9 (22.50)	5 (17.86)	23 (23.00)
Rice + maize + ginger + vegetables + colocasia + pumpkin + cotton + okra	CM III	6 (18.75)	10 (25.00)	7 (25.00)	23 (23.00)
Rice + ginger + vegetables + turmeric + chilli + sesamum + mustard	CM IV	9 (28.13)	10 (25.00)	10 (35.00)	29 (29.00)
Total		32 (100)	40 (100)	28 (100)	100 (100)

Results and discussion

Identification of cropping sequences and crop mixtures under settled and shifting cultivation

Among the various cropping sequences raised by the sample farmers under settled cultivation, CS 10 (ahu rice-Sali rice-fallow) was the major cropping sequence followed by about 18% of the total sample farmers and accounting 37.46% of total cropped area. However CS 3 was the major cropping sequence followed in the upland in terms of area coverage. In medium land CS 7 was the major cropping sequence followed by 9% of the sample farmers (Table 1).

Crop mixture IV (rice + ginger + vegetables + chilli + sesamum + mustard) was the dominant crop mixture under shifting cultivation adopted by 29% of the total farmers. This was followed by rice + maize + ginger + vegetables + colocasia + marua (25%) and rice + ginger + vegetables + pumpkin + cotton + okra (23%), and rice maize + ginger + vegetables + colocasia + pumpking (23%), respectively (Table 2). The major difference occurred mainly in the inclusion of one or more crops in the mixtures.

Economics of settled and shifting cultivation

The cost and return of different identified cropping sequences under settled cultivation and different crop mixtures under shifting cultivation was computed separately and then total production cost and total gross return were estimated and finally net return and output–input ratio were estimated. The results of the cost and return under settled and shifting cultivation are presented in tables 3 and 4. The tables revealed that output–input ratio in both settled and shifting cultivation were more than equity. However, the estimated output–input ratio in shifting cultivation was found to be higher (2.18) as compared to settled cultivation (1.77). Saikia and Bora (1971) also reported that the return

Table 3: Cost and Return of Settled Cultivation in Various Size Groups of Farm

Particulars	Group-I	Group-II	Group-III	All
1. Total production cost	5987	6101	6403	6168
2. Total gross return	10721	10916	11140	10925
3. Net return	4734	4815	4737	4757
4. Output–input ratio	1.79	1.79	1.74	1.77

Table 4: Cost and Return of Shifting Cultivation in various Size Groups of Farm

Particulars	Group-I	Group-II	Group-III	All
1. Total production cost	8026	9444	8579	8683
2. Total gross return	12104	14819	13241	13387
3. Net return	4078	5375	4662	4704
4. Output–input ratio	2.03	2.32	2.32	2.18

Table 5: Food Balance Sheet of Various Size Groups of Farms under Shifting Cultivation

Size groups	Particulars	Cereals (minimum recommended)	Oilseeds (minimum recommended)	Fuels (minimum recommended)
	Requirement/adult/day	370 gms	38 gms	2.015 kg
Group -I	Production (q)	6.75	0.26	45.00
	Consumption (q)	10.95	0.55	31.03
	Surplus/deficit	-4.20(38.26)	-0.29(52.73)	13.97
Group-II	Production (q)	15.27	1.23	45.00
	Consumption (q)	13.69	0.73	38.85
	Surplus/deficit	1.58	0.50	6.15
Group-III	Production(q)	28.60	2.10	50.00
	Consumption (q)	15.25	0.77	42.34
	Surplus/deficit	13.35	1.33	7.66

Note: Figures in parentheses indicate percentage of deficit

Table 6: Food Balance Sheet of Various Size Groups of Farms under Settled Cultivation

Size groups	Particulars	Cereals (minimum recommended)	Oilseeds (minimum recommended)	Fuels (minimum recommended)
	Requirement/adult/day	370 gms	38 gms	2.015 kg
Group-I	Production (q)	2.84	0.14	100.00
	Consumption (q)	6.22	0.64	33.38
	Surplus/deficit	-3.38(54.34)	-0.50(78.13)	66.12
Group-II	Production(q)	9.99	0.49	90.00
	Consumption (q)	6.12	0.63	33.30
	Surplus/deficit	3.87	-0.14(22.22)	56.70
Group-III	Production (q)	24.56	0.20	150.00
	Consumption(q)	13.14	0.69	36.75
	Surplus/deficit	11.42	-0.49(71.01)	113.25

per unit of land from mixed crops was much higher then in shifting cultivation than terrace cultivation in hilly areas of north east India. But considering the ecological effect of shifting cultivation, this higher ratio should not be permanent and considered to be better than the settled cultivation. The variation in output–input ratio amongst the size groups of farm was due to difference in variable costs incurred by the sample farmers. However, the net return per hectare under settled cultivation was higher than that of shifting cultivation. This might be due to higher productivity of crops, especially paddy, in settled cultivation compared to shifting cultivation. Chauhan (2001) reported that yield of paddy in shifting cultivation was 15.20% less as compared to settled cultivation due to agro-economic consequences of the system.

The food balance sheet under settled and shifting cultivation was prepared for cereal, oilseeds, and fuels and presented in tables 3 and 4. The tables reveal that all the groups under settled and shifting cultivation could not only meet the demand for cereals but also generated a substantial surplus except Group-I farms which generate a substantial quantum of deficit. The productions of oilseeds increased to a great extent in the production plan. Fuelwood production in all the systems was found to be satisfactory, which showed a substantial surplus. This was

mainly due to the fuelwood produced from the dead and lopping branches of other plantation crops and other agricultural wastages apart from fuelwood produced from firewood and bamboo trees.

The production of cereals under both the systems of settled and shifting cultivation was found to generate a deficit quantum of 4.20, 3.38, and 0.50 quintals in Group-I farms. In Group-II and Group-III farms, cereals were found to be satisfactory under settled and shifting cultivation. The oilseed production was found to be satisfactory under shifting cultivation except in case of Group-I farms while it was found to be not satisfactory in all the groups of farms under settled cultivation.

Conclusion

The following conclusions could be drawn from the above results and discussions.

1. The output–input ratio was higher in shifting cultivation than that of settled cultivation. However the per hectare net return was higher in settled cultivation than that of shifting cultivation.
2. The fuels production was found to be satisfactory in all the systems and groups of farms.

Policy Implication

The existing production plan under settled and shifting cultivation throws some light on drawing the appropriate strategy in order to attain sustainable agriculture which will provide a minimum normative requirement of food, forest coverage, maintenance of soil fertility status, and minimum standard of living. The multistoried crop canopy with perennial crops, such as banana and pineapple at the top layer, cereals constituting in the middle layer, and vegetables and pulses at the lower stratum could be suggested to bridge the production gap of existing production.

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When faced with a challenge, look for a way, not a way out.

—David Weatherford

Focus

Total Productive Maintenance-A Dynamic Enabler to Manage Productivity in a Manufacturing Organization

S.K. CHAKRAVORTY

In most of our manufacturing organizations, the maintenance departments are considered a necessary evil than the foundation of our manufacturing processes and integral part of customer's satisfaction team. But by following Total Productive Maintenance philosophy, any manufacturing organization can be made world class by eliminating six big losses. The author has dealt with the types of losses and the TPM implementation steps to maximize overall equipment effectiveness (OEE) in the manufacturing set-ups. Some benefits achieved by various organizations has been also discussed based on the studies carried out by the author in those organizations.

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1. What is Total Productive Maintenance?

1.1 Total Productive Maintenance (TPM) is a method for continuously improving the effectiveness of all production equipment in the organization.

TPM is a concept of total management of physical assets. The key difference between TPM and other maintenance improvement initiatives (such as Preventive Maintenance or predictive Maintenance) is that TPM requires the involvement of all people in the organization.

1.2 TPM is far more than cleaning, lubrication and tightening nuts and bolts, it is a dynamic, time based methodology for involving all employees in identifying and eliminating equipment related losses such as equipment failure, lengthy set up time, inconsistent adjustment procedures, idling and minor stoppages, reduced production yields, process defects, etc.

The philosophy of TPM is to transform the attitude of all the members of the industrial community. All kinds and levels of workers, operators, supervisors, engineers, and administrators are included in this major responsibility. TPM philosophy contains

- Team working and respect for people at all levels
- Motivation and people at all levels
- Participation and encouragement
- Positive leadership and support
- Enhance skill and experience
- Recognition of effort and providing incentives

2. Maintenance—A Neglected Management Function

2.1 Over the years, maintenance has been, and still is the most neglected part of our industries. Today, in most of the industries, the maintenance department is considered more a necessary evil than the foundation of our manufacturing processes and an integral part of customer's satisfaction team. Maintenance people are rarely involved in process improvement or customer related activities.

2.2 As a result of our failure to lead and properly guide the maintenance function and our corresponding low expectations from our maintenance people, we have over the years, developed a group of people with following characteristics:

- Maintenance personnel want maintenance department to be located as far away from production department as possible
- Maintenance personnel have little regard for production process.
- Machine Maintenance is handled as the fire fighting strategy
- The reasons given for management's inattention to maintenance improvements are:
- Not enough people
- No parts in stock
- The equipment is never scheduled to be down for maintenance

2.3 Additionally we have prompted this separation and lack of plant-wide teamwork by allowing our machine operator to tell our maintenance people "We only run equipment, we don't fix it."

2.4 TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer neglected as a non-profit activity. Down time for maintenance is scheduled as a part of the manufacturing day and in some cases as an integral part of the manufacturing process. Maintenance is no longer simply squeezed in whenever there is a break in material flow. The goal is to hold emergency and unscheduled maintenance to a minimum.

3. Origin of TPM

3.1 TPM has evolved from TQM. Philosophically, TPM resembles TQM in several aspects such as:

- Total commitment of top management
- Employees must be empowered to initiate corrective action
- Long range outlook and ongoing improvement process

3.2 When the problems of plant maintenance were examined as a part of the TQM programme, some of the general concepts did not seem to fit or work well in maintenance environment. Preventive Maintenance (PM) procedures had been in place for some time and PM was practiced in most plants. Using PM techniques, maintenance schedules designed to keep machines operational, were developed. However, this technique often resulted in machines being over-serviced in an attempt to improve production. Manufacturer's maintenance schedules had to be followed strictly with little thought as to the realistic requirements of the machine. There was little or no involvement of the operator in the maintenance programme and maintenance personnel had little training beyond what was contained in often inadequate maintenance manuals.

3.3 The need to go further than just scheduling maintenance in accordance with manufacturer's recommendations as a method of improving productivity was quickly recognized by those companies who were committed to the TQM programmes. To solve this problem and still adhere to the TQM concepts modifications were made to the original TQM concepts. These modifications evaluated maintenance to the status of being an integral part of overall quality programme and named as TPM.

3.4 TPM was first implemented in the late 1960s by Nippondenso, a Japanese manufacture of automotive electrical parts. Seiichi Nakajima, an executive with the Institute of Plant Maintenance in Japan is credited with defining the concepts of TPM and seeing it implemented in hundreds of plants in Japan.

3.5 In the U.S. Kodak's Tennessec Eastmen facility is acknowledged as the TPM pioneer for their 1987 implementation.

4. How does Implementing TPM Improve Productivity?

4.1 TPM strives to increase operator's value added time by eliminating the six big losses, which reduce operator and equipment productivity and create waste. These losses are:

i. Equipment failure/Breakdowns

ii. Set-up/Adjustment

The first two big losses are known as "down time" losses, and are used to help to calculate a true value for the availability of a machine.

iii. Idling and minor stoppage

iv. Reduced speed

The 3rd and 4th big losses—"Speed Losses" are factors that determine the performance efficiency of a machine.

v. Reduced Yield

vi. Scrap

The final two losses are considered to be losses due to "defects" and the larger the number of defects the lower the quality rate of parts within the plant.

4.2 It is possible to calculate a percentage figure for each group of losses thus:

Percentage availability is the ratio of how long you had actually used the machinery over how long you wanted to use the machinery.

% Availability = [(Loading time – Break Down & Set-up loss) / (Loading time)] X 100

where loading time = Planned production time – breaks – planned maintenance time.

A simple example where loading time = 8 hours

Breakdowns = 1 hour and Change overs/set-up = 1 hours

Thus % availability = [(8 – (1 + 1) / (8)] x 100 = 75%

4.3 Percentage performance is the ratio of what was actually produced in a given time and what you would have expected to be produced in a given time and this can be calculated in two ways:

The first method is:

% Performance = [(Quantity Produced) / (Time run x capacity per unit time)] X 100

A simple example is where the quantity produced = 500 parts/time run 6 hrs and capacity = 100 parts per hour

% Performance = [(500) / (6 x 100)] X 100 = 83%

This formula is preferable where many products or bulk quantities are produced in a relatively short time.

The second method is:

% Performance = [(time run – minor stoppages – reduced speed)/(time run)] X100

4.4 A simple example is where time run = 6 hours; minor stoppages total = ½ hour and reduced speed equivalent = 1 / 2 hour lost

%Performance =[(6 ½ – ½) /6] X 100 = 83%

This formula is preferable where only few parts are produced per day or per week or even per month or year.

4.5 Percentage quality is the ratio of the number of good products over total products produced during a given period of time and again can be calculated in two ways.

The first method is:

% quality = [(amount produced – amount defects – amount reproduced) / amount produced] X 100

A simple example is where the quantity produced = 500 products; the amount defective = 50 and the amount reproduced = 50

% quality = [(500 – 50 – 50) / (500)] X 100 = 80%

This formula is preferable where many products or bulk quantities are produced in a relative short time.

4.6 Where this is not the case, it may be necessary to record the amount of time spent producing reject parts and the amount of time spent reprocessing parts. In this case the calculation is:

% quality =[(time run – defect time – reprocessing time)/(time run)] X 100

A simple example is where time run = 6 hours; the time spent producing defects = 36 minutes and time spent for reprocessing = 36 minutes.

% quality = [(6 – 36/60 – 36/60) / (6)] X 100 = 80%

4.7 Overall Equipment Effectiveness (OEE) is a measure of all three of these factors and although it is not strictly a percentage, it is usually represented in percentage terms and calculated as:

Overall = 0.75 x 0.83 x 0.9 x 100 = 50%

4.8 The OEE value has many purposes:

- OEE is a method of measuring the starting position of a plant and can be compared with further OEE values, which will be calculated after improvements.

- OEE value calculated for individual machine on a manufacturing line can also be compared to identify any bottlenecks occurring.
- If the machines work individually instead of a line, the OEE value can identify which machine is performing the worst and, therefore, improvement plans can be prioritized.

5. **Implementation of TPM**

5.1 Implementation of TPM requires commitment and a clear understanding of TPM goals. A growing number of Indian industries are coming to understand the positive impact that a TPM can have in creating more efficient and cost effective production. But experts warn that the implementing TPM can be a long and involved process that requires a strong commitment from people at all levels of the organization.

5.2 A thorough TPM implementation includes the following eight fundamental development activities:

- **Focused Improvement:** Cross-functional project teams composed of people such as engineers, maintenance personnel, and operators participate in activities designed to minimize targeted losses.
- **Autonomous Maintenance:** TPM recognizes that the equipment owner–operator has the most expertise and knowledge in the facility about the normal operation of the equipment. When this equipment knowledge is combined with training to complete prestart-up preventive maintenance activities, the owner-operator becomes a powerful tool in preventing breakdowns. This type of operator maintenance activity is referred as independent or autonomous maintenance. Here, operators perform routine maintenance tasks and participate in improvement activities that halt accelerated deterioration, control contamination and maintain optimal conditions. Autonomous maintenance is typically implemented in seven steps. Putting the owner-operator in control of the machines helps eliminate breakdowns.
- **Planned Maintenance:** Planned or scheduled maintenance embraces three forms of maintenance: breakdown, preventive, and predictive. Planned maintenance activities emphasize monitoring mean times between failures (MTBF) and using that analysis to specify the intervals for tasks in annual, monthly, and weekly maintenance calendars. Like other TPM activities, building a planned maintenance system should be done systematically, one step at a time.
- **Training-Implementing TPM** is also a continuous learning process—operators and maintenance personnel in particular must receive training to upgrade their equipment related skills and knowledge. Plant managers and corporate managers must educate themselves about TPM and may even participate in model equipment restorations.
- **Early Management:** This activity includes both early product management and early equipment management. The purpose of these activities is to achieve quickly and economically products that are easy to make and equipment that is easy to maintain and use.
- **Quality Maintenance:** This is a set of activities designed to build in quality and prevent quality defects. In quality maintenance, variability in a product quality characteristic is controlled by controlling the equipment components that affect it.
- **TPM in Administrative and Support Departments:** While the production and maintenance are engaged in TPM activities on the shop-floor, administrative functions should aim to create "information factories" and apply process analysis to streamline information flow. Think of administrative and support departments as process plants whose principal tasks are to collect, process, and distribute information.
- **Safety and Environmental Management:** Assuring safety and preventing adverse environmental impacts are important priorities in any TPM effort.

6. The Results of TPM

6.1 Ford, Kodak, Dana Corp., Allen Bradely, Harley Davind son, are just a few U.S. Companies besides hundreds of plants in Japan who have implemented TPM successfully. Indian industries such as, Crompton Greaves, Larsen & Toubro (L&T), Hindustan Lever Ltd. (HLL), Hindalco Ltd., Grasim Industries, Marico Industries, Sundram Fasteners, Electrosteel Castings, etc.; are equally successfully implemented TPM. All reports an increase in productivity using TPM. Production figures increases up to 80% in some areas, almost all the above named companies reported 50% greater reduction in down time,

reduced spare parts inventory, increased on-time deliveries, etc.

7. Conclusion

7.1 Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. It has been proven to be a programme that works. Employees must be educated and convinced that TPM is not just another "Programme of Mouth" and the management has to be totally committed to the programme and the extended time frame is necessary for full implementation. If everyone involved in a TPM programme does his or her part, an unusually high rate of return compared to resources invested may be expected.

People are sometimes afraid that the TPM will take their jobs. On the contrary, the idea of TPM is to create a higher level of maintenance, the maintenance personnel are not repairmen, but the up-keepers of the equipment. They need higher levels of skill to perform in this new environment. The operators work to maximize OEE and in the process they become very knowledgeable about their equipment and perform normal daily maintenance of the equipment. The gradual transfer of cleaning, inspection, lubrication and bolt tightening tasks to operators frees up maintenance people to do more specialized maintenance.

Therefore, TPM is going to make maintenance crew and operators jobs easier, faster, safer and productive and through TPM breakdowns are to be eliminated and not the people. TPM is not "Totally Painted Machines", it is "Taking Pride in our Machine" by keeping it in show room condition and achieving zero breakdowns, zero defects, and zero accidents.

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NPC – Study Reports for different companies

Above all, challenge yourself. You may well surprise yourself at what strengths you have, what you can accomplish.

—Cecile Springer

Feature

Economics of Selected Crops under Different Organic Practices

BRIJ BALA, K.D. SHARMA AND POONAM CHANDEL

The study aims at providing the empirical evidence on the profit maximizing organic practices and their combinations that can be used for the cultivation of different crops. The study was conducted on the Model Organic Research Farm of CSK HPKV, Palampur that was established in the year 2006. Cost of production of organic inputs viz., Vermicompost, Nadep compost, Vermiwash, Matka khad, BD compost, CPP compost, Compost tea, Agnihotra ash, and Truimbecum ash was calculated as Rs 1.91, Rs 1.51, Rs 4.43, Rs 1.85, Rs 2.18, Rs 10, Rs 1.11, Rs116.13, and Rs 717.79, respectively. Maximum net returns (Rs 74,286) were obtained for maize crop under organic practice P11 (FYM @ 10 t/ha + BD @ 1t/ha+ VC @ 5 t/ha + Intercrop [soybean]). For wheat, maximum net returns were obtained from P4 (FYM @15 t/ha + BD @ 1 t/ha). In case of soybean highest yields and net returns were obtained under Panchang sowing with application of homabhasam @ 2 kg/ha and Matka khad @ 100 liter/ hectare. FYM @ 15 t/ha in conjunction with VC @ 5 t/ha proved to be the best practice for pea crop. It was suggested that the most economic organic practices for different crops identified in the study should be included in the package of practices and made popular among farmers. The farmers should be encouraged and trained through professional diploma courses to produce the organic inputs and take up organic farming as a commercial venture. The need to simplify organic certification and promote organic marketing system was also stressed.

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The introduction of high-yielding variety seeds after 1965 and the increased use of fertilizers and irrigation, collectively known as Green Revolution, provided the impetus to production needed for making India self-sufficient in food grains. However, this Green Revolution bonanza could not sustain itself for long and is being blamed for the spread of land degradation in India due to imbalanced and excessive use of fertilizers, pesticides, etc. This capital intensive technology put heavy debt charge on resources. The scientists have already sounded an alarm bell that with the graying of Green Revolution, the overall Indian agriculture is in crisis (Dahiya, 2001, p. 13).

As such, over the past few years, organic agriculture has entered the global agriculture scene as a potential alternative tool providing opportunities for economically and ecologically prudent and sustainable farming. Thus, organic farming is deemed as one of the best alternatives to escape from the vicious cycle of debt and resource degradation. The driving force is also provided by the consumers who do not want to be poisoned with toxic food residues originating from conventional farming (Thakur and Sharma, 2005, p. 205). It is also necessary from small farmers' perspective to use organic practices who cannot afford capital intensive farming.

Organic farming is certainly an answer to make safe food, clean eco-system and to bring stability and sustainability of agriculture (Raj and Bhardwaj, 1995, p. 13). The farmers in hilly regions have the opportunity to enter organic agriculture by default due to climatic conditions, topography, rainfall, etc. The rain-fed, tribal, northeast, and hilly regions of the country where negligible quantities of chemicals are used, are practicing subsistent agriculture for a long period. Hence, these

areas are organic by default. But the movement of organic farming is constrained because of the lack of scientific support.

The comparative strengths and weaknesses of organic and inorganic systems are continuously being debated. Farmers are waiting to be told what combinations among the range of organic practices would be more suitable and economically viable for them because farmers will be able to adopt organic practices only when they are assured of better economic returns and stable production. Farmers also want to insure the timely availability of inputs, technical know-how, assured market, premium prices and easy certification process, before venturing into organic farming (Bala, 2010, p. 45). There are very few studies on economic aspects of organic farming. Therefore, the present study was aimed at providing empirical evidence on the profit maximizing organic practices and their combinations for different crops which in turn will satiate the curiosity of farming community. Precisely, the objectives of the study were:

- to work out the cost of production of various organic inputs;
- to work out the economics of crops vis-à-vis organic practices and to identify the organic practices for higher returns.

Methodology

The present study was undertaken on the 'Model Organic Research Farm' of Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya (CSK HPKV), Palampur. The farm was established on 15 April 2006. The Organic Farm is located at 32°6' N latitude and 76°3' E longitude at an elevation of 1229.4 meters above mean sea level in North Western Himalayas. It has an area of around 15.85 ha, of which only 2.66 ha is the cultivated area.

Selection of crops

The crops on the organic farm were given importance in the cropping pattern on the basis of their performance under different organic practices during the previous years. Maize, wheat, soybean, and pea crops occupied a sizeable proportion of the total cropped area on the farm during the period under study and hence, were selected for the study.

Data collection

Both primary and secondary data were used for the study. The data were collected on various aspects through regular personal observations and from the records maintained on the farm. The data were collected on various inputs and costs involved in the production of organic inputs viz., composts, bio sprays, homa farming, and biodynamic inputs. Similarly, the information was gathered about the various practices being used in selected crops along with the cost and returns structure for these crops under different organic practices for the agricultural year 2008–09.

Analytical framework

In order to meet the specified objectives of the study, different analytical tools were employed for analysis and interpretation of the data. Tabular method of data analysis was extensively used in the study.

Results and Discussion

Organic practices and input costs

One of the main goals of an organic farm is to maintain long-term soil fertility and productivity by supplying the essential nutrients. The regular addition of composts is one of the best ways to enhance soil organic and nutrient content, which help to build a fertile soil structure. The organic farm had been producing different organic composts to meet the nutrient requirements of different crops. These composts were generally of two types—solid composts and liquid composts. Solid composts, which included vermicompost (VC), biodynamic (BD) compost, Nadep and Cow pit pat (CPP) compost, were used at sowing and earthing-up time of the crops. Liquid composts viz., vermiwash (VW), matka khad (MK), compost tea (CT) and biosol, were sprayed after the establishment of crop. The program framework of the model organic farm was set up by the categorization of several organic practices into four major groups, which are as under:

1. **Homa farming:** Homa farming included "Agnihotra" and "Triumbecum" activities on the farm to produce "Agnihotra" and "Triumbecum" ash.
2. **Vedic krishi:** Vedic Krishi included the use of Vermicompost, Nadep compost, Vermiwash, and Matka khad.
3. **Biodynamic farming:** Components of biodynamic were cosmos calendar (panchang calendar), BD compost, liquid manures, and sprays. Panchang calendar was based on the Indian ephemeris of planet positions. Agricultural practices were performed as per constellation of

moon. According to Panchang calendar sowing, transplanting, grafting, pruning, layering, and spraying liquid sprays were done when moon was opposite to Saturn. All agricultural activities were avoided in moon nod (for example, eclipse). Spray of bio-pesticides to manage pests and diseases was performed in perigee (moon is closest to earth) and avoided sowing of seeds in new moon. Liquid sprays and manure application were done at ascending and descending periods.

There were many BD preparations used for making BD compost and the concept behind these preparations was that these mediate the influences of the planets of solar system and living beings in the ethnic formative forces into heap. BD preparations used were BD500, BD501, BD502, BD503, BD504, BD505, BD506, and BD507.

4. **Effective microbes:** Components included were micro-flora and microbes which act as inoculants in the compost for enhancing fertility. For example, *Trichoderma harzianum* (SMA-5), *Trichoderma koningii* (DMA-8), *Azotobacter chrococcum*, *Aspergillus awamorii*, and *Pseudomonas fluorescens*.

Since the cost of organic inputs has a bearing on economics of organic farming/crops, it was felt imperative to find out the various costs involved in their production. The economics of different types of composts prepared under all the above said categories has been worked out and presented in Table 1. The per kg cost of Vedic composts viz., Vermicompost and Nadep compost came out to be Rs 1.91 and Rs 1.51, respectively, while that of Vermiwash and Matka khad was Rs 4.43 and Rs1.85 per liter. In all these Vedic composts, the variable cost accounted for more than 90% of the total cost. The cost of biodynamic compost came out to be Rs 2.18 per kg while cost of compost tea was Rs 1.11 per liter. The cost of enriched CPP compost was Rs 10 per kg. The cost of Homa farming inputs namely "Agnihotra" ash and "Truimbecum" ash was quite high to the tune of Rs 116.13 and Rs 717.79 per kg, respectively. The high cost of Homa farming ash was attributed to the use of costly *desi* ghee in its preparation. However, the cost of Biosol (liquid compost) based on Homa farming was estimated at Rs 1.35 per liter. Costs of these composts were quite low in comparison to market prices. Therefore, efforts need to be directed toward production of sufficient intermediate inputs/biomass and upscale animal component so as to produce the required quantity of organic composts. The farmers should be trained to produce these cost-effective organic inputs so as to promote organic farming in Himachal Pradesh.

Table 1: Cost of Preparing Organic Composts on Organic Research Farm (Rs)

Organic Compost	Capital Investment	Fixed cost (per annum)	Variable cost (per annum)	Total cost	Estimated production	Cost per liter/kg	
						Variable cost	Total cost
Vermicompost	7000	198.32	5538.54	5736.86	3000 kg	1.84	1.91
Nadep compost	6685	581.66	1575.83	2114.49	1400 kg	1.13	1.51
Vermiwash	2016	343.20	1254.00	1597.20	360 liter	3.48	4.43
Matka khad	1920	455.2.00	2880.00	3335.20	1800 liter	1.60	1.85
Biodynamic compost	1930	166.25	5160.00	5326.25	2440 kg	2.11	2.18
CPP compost	1730	126.91	569.71	696.62	70 kg	8.14	10.00
Compost tea	2830	489.00	8044.80	8533.80	7680 liter	1.05	1.11
Agnihotra ash	10285	1242.75	8790.72	10033.47	86.4 kg	101.74	116.13
Triumbecum ash	200285	24042.75	22470.00	46512.75	64.8 kg	346.76	717.79
Biosol	1005	59.37	346.00	405.37	300 liter	1.15	1.35

Cropping pattern on organic farm

Cropping pattern followed on organic farm during 2008–09 has been given in Table 2. It can be observed from the table that the cereal crops were given the maximum proportion (35%) of the total cropped area. Maize and wheat were the major cereal crops grown on the farm. Barley, paddy, oat, and bajra were among other important cereals. Fodder crops were next in importance occupying about 16% of the cropped area followed by oilseed crops (15%). Among oilseeds soybean occupied the maximum proportion while Dhaincha and Setaria were the major fodder crops grown on the farm. Vegetables, medicinal plants, and spices were also given due importance in the cropping pattern. Cropping intensity realized on the farm was about 176%.

Table 2: Cropping pattern on Organic Farm, 2008-09

Crops	Area	
	ha	percentage
Cereals		
Maize	0.268	5.72
Barley	0.183	3.91
Bajra	0.116	2.48
Wheat	0.371	7.92
Wheat and gram	0.134	2.85
Others	0.576	12.32
Sub-total	**1.648**	**35.2**
Pulses		
Cowpea	0.063	1.35
Lentil	0.076	1.63
Others	0.134	2.87
Sub-total	**0.273**	**5.85**
Vegetables		
Pea	0.190	4.06
Other vegetables	0.218	4.66
Sub-total	**0.408**	**8.72**
Oilseeds		
Soybean	0.468	10.00
Other oilseeds	0.254	5.42
Sub-total	**0.722**	**15.42**
Fodder		
Dhaincha	0.187	4.00
Setaria	0.145	3.11
Other grasses	0.423	9.04
Sub-total	**0.755**	**16.15**
Spices		
Ginger	0.280	5.99
Turmeric	0.063	1.34
Sub-total	**0.343**	**7.33**
Medicinal plants		
Aloe-vera	0.165	3.52
Lemon grass	0.109	2.34
Other medicinal plants	0.126	2.68
Sub-total	**0.400**	**8.54**
Fruits (Guava+strawberry)	**0.129**	**2.75**
Total cropped area	**4.678**	100.00
Net sown area	**2.660**	–
Cropping intensity (%)	**175.86**	–

Economics of crops under different organic practices

Organic agriculture includes management practices such as no-till and cover cropping to minimize erosion, reduction of pests through rotation, use of manures and natural fertilizers, and biological methods of pest control. A farmer can reconcile between short-term risks and long-term benefits with alternative farming system. Before farmers adopt an alternative system, they must be convinced that the economic benefits from the alternative farming system clearly surpass the costs incurred. In this section of the study, an attempt has been made to compare the economics of different crops with different organic practices and to find out the best organic practices.

Cost and returns structure for maize with different organic practices

It can be observed that there were 11 different practices used for the production of maize on the organic farm (Table 3). Farm Yard Manure (FYM) at varied rates was the main component of most of the practices. Conjunction of Vermiwash @ 14 literer per ha with Neemastra @ 7.5 liter per ha, and Compost tea @ 50 liter per ha were commonly used in P6, P7, P8, and P9 whereas combination of Vermiwash @ 14 liter per ha and Neemastra @ 7.5 liter per ha was used in P1, P2, P3, and P4. In P10 and P11, soybean was taken as an intercrop with maize to interpret the effects of intercropping a pulse crop with cereals. As is evident from the table, the cost of organic inputs (composts and biosprays) constituted the maximum proportion of the total variable cost in all the practices. It was followed by human labor. Other charges which included the cost of seed, tractor charges for land preparation, irrigation charges, and interest on working capital, also constituted about 10–18% of the costs under different practices. Most of the human labor was employed at the time of weeding, application of composts and biosprays. The total variable cost was observed to be highest (Rs 39, 264) for P6 and lowest (Rs 19,068) for P4.

Table 3: Economics of different organic practices used in maize

Organic practice			Yield (q/ha)	Variable cost			Returns (Rs/ha)			Input Output Ratio
				Cost components %			Total (Rs/ha)	Gross returns	Net returns	
No.	Compost	Biospray (liter)		Organic inputs	Human labor	Other charges				
P1	FYM @ 20 t	Vermiwash @ 14+ Neemastra @ 7.5	17.91	51.1	19.07	19.07	20093	45671	25578	2.27
P2	FYM @ 15 t + VC @ 5 t	Vermiwash @ 14 + Neemastra @ 7.5	26.63	63.6	14.71	14.71	27214	67907	40693	2.50
P3	FYM @ 15 t + BD @ 1 t	Vermiwash @ 14 + Neemastra @ 7.5	29.16	51.5	19.79	19.79	19166	74358	55192	3.88
P4	FYM @10 t + BD @ 2 t	Vermiwash @ 14 + Neemastra @ 7.5	28.05	49.6	19.95	19.95	19068	71528	52460	3.75
P5	FYM @10 t + BD @ 1 t + VC @ 5 t	Compost tea (1:10) @ 50	25.50	62.1	14.8	14.8	26891	65025	38134	2.42
P6	VC @ 15 t	Vermiwash@14+ Neemastra@7.5+ Compost tea @ 50	17.34	73.8	10.94	10.94	39264	44217	4953	1.13
P7	BD @ 5 t	Vermiwash@14+ Neemastra@7.5+ Compost tea @ 50	21.13	52.5	18.57	18.57	20710	53882	33172	2.60
P8	VC @ 10 t + BD @ 1 t	Vermiwash@14+ Neemastra@7.5+ Compost tea @ 50	25.23	67.6	12.93	12.93	31840	64337	32497	2.02
P9	VC @ 5 t + BD @ 2 t	Vermiwash@14+ Neemastra@7.5+ Compost tea @ 50	27.35	58.1	16.24	16.24	24195	69743	45548	2.88
P10*	FYM @ 20 t + Intercrop (soybean)	Cow pat pit @ 25	21.29 34.50 13.21 (1.62)	47.5	19.87	19.87	21464	87975	66511	4.10
P11	FYM @ 10 t + BD @ 1 t + VC @ 5 t + Intercrop (soybean)	Compost tea (1:10) @ 50	25.92 42.00 16.08 (1.62)	58.9	15.66	15.66	28280	99450	71170	3.52

Note: Other charges include seed cost, tractor charges, irrigation charges and interest @ 10% on working capital.
*Best practice.
Figures in parentheses show Land Equivalent Ratios (LER) of intercropping.

It was observed that the practices P10 and P11 resulted in the higher grain yield than the other practices. Yield of maize from these practices was higher due to intercropping with soybean. Average Land Equivalent Ratio (LER) of maize and soybean on the farm was 1.62 which is also supported by Ullah et al. (2007, p. 113) which indicated that 62% yield advantage was obtained when grown as intercrops as compared to those grown as sole crops. Present study corroborated the findings of Mehta and Day (1980, p. 117), Seran and Brintha (2009, p. 1153) and Tsubo, Walker, and Ogindo (2005, p. 23) who have reported the yield to be taken as primary consideration in the assessment of the potential of intercropping practice.

Intercropping is one of the vital practices of the organic farming, as it ensures better utilization of resources, minimizes the risks, reduces weed competition, and stabilizes the yield. Among the sole maize crop, practice P3 (FYM @ 15 t/ha + BD @ 1t/ha) yielded maximum (29.16 q/ha). A price premium of 20% for organic produce was assumed over those produced under conventional farming. Gross returns as well as the net returns were highest for P11 followed by P10 however, the input–output ratio turned out to be highest for P10 followed by P3. Thus, intercropping provided higher cash returns than growing the crop alone. These findings were in conformity with earlier reports of Karla and Ganger (1980, p. 187) and Ahmad and Rao (1982, p. 147).

Table 4: Economics of different organic practices used in wheat

Organic practice			Yield (q/ha)	Variale cost			Returns (Rs/ha			Input Output Ratio
				Cost components %			Total (Rs/ha)	Gross returns	Net returns	
No.	Compost	Biospray (liter)		Organic inputs	Human labor	Other charges				
P1	FYM @ 20 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	20.85	41.4	24.57	34.05	24426	64114	39688	2.62
P2	FYM @ 15 t + VC @ 5 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	23.45	53.73	19.42	26.85	31935	72109	40174	2.26
P3	FYM @ 10 t + BD @ 10 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	23.19	62.14	15.40	22.45	38959	71309	32350	1.83
P4	FYM @10 t + BD @ 1 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	28.38	40.22	25.24	34.53	24165	87269	63104	3.61
P5	FYM @10 t + BD @ 2 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	27.81	39.37	25.38	35.24	23641	85516	61875	3.62
P6	VC @ 15 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	18.37	65.34	14.77	19.9	44014	56488	12474	1.28
P7	BD @ 5 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	19.25	41.57	25.74	32.69	25641	59154	33513	2.31
P8	VC @ 10 t + BD @ 1 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	24.94	55.71	21.58	22.71	38269	76691	38422	2.00
P9	VC @ 5 t + BD @ 2 t	Compost tea (1:10), VW+CU(1:1:10), FBM+ CU(1:1:10)	24.42	48.09	22.56	29.35	28819	75092	46273	2.61
Con-trol			17.14	0	47.96	52.04	15637	52706	37069	3.37

Note: Other charges include seed cost, tractor charges, irrigation charges and interest @ 10% on working capital.
*Best practice.

Cost and returns structure for wheat with different organic practices

Different practices used for wheat on the organic farm and their economics has been presented in Table 4. Nine practices along with tenth as a control were used in wheat. Farm yard manure, vermicompost and biodynamic compost were used at varied rates in nine practices and were supplemented with compost tea, vermiwash, fermented butter milk (FBM) and cow urine (CU) as biosprays. Among the nine practices, the practice P6 incurred the highest costs (Rs 44,014) and P5 (Rs 23,641) turned out with the minimum variable cost. Organic inputs and human labor were the major components of the total cost involved in all the practices. The cost incurred for control where no composts and biosprays were used, was Rs 15,637 and human labor formed the major proportion of it.

It can be observed from the table that the highest yield of wheat was realized from P4 (28.38q/ha) followed by P5 (27.81q/ha). Among different organic practices minimum yield was obtained under P7 where only BD compost was used with equal quantity of biosprays. This indicates that the other practices, where vermicompost and FYM was used yielded better as compared to the practice with BD compost only. Under control the yield obtained was about 17q/ha. The gross returns as well as the net returns were also highest for P4 followed by P5. It was interesting to note that the net returns obtained under control were quite comparable with those obtained from most of the organic practices and were even higher than P6, P3, and P7. The input–output ratio was highest and almost equal for P4 and P5. This ratio for control exceeded the input-output ratio for all other practices because the cost incurred for control was quite low.

Cost and return structure for soybean with different organic practices

In case of soybean, the main organic practices included the use of biodynamic calendar for various cultural operations viz., sowing of seeds and manorial schedule. The same was supplemented with the biosprays of Homabhasam and Matka khad (Table 5) No composts were used in any of the practices except P7 where FYM was used to the tune of about 50% of the total cost. It is evident from the table that seed attributed maximum (upto 55%) towards the cost. The share of human labor varied from 7 to 14% under different practices. It can

Table 5: Economics of different organic practices used in soyabean

Organic practice			Yield (q/ha)	Variale cost			Returns (Rs/ha			Input Output Ratio
				Cost components %			Total (Rs/ha)	Gross returns	Net returns	
No.	Compost	Biospray (liter)		Organic inputs	Human labor	Other charges				
P1	Panchang sowing	Homabhasam @ 2	17.10	1.67	14.10	84.22	9219	43178	33959	4.68
P2	Panchang sowing	Homabhasam @ 2+ Matka khad@100	20.40	3.46	14.33	82.21	9076	51510	42434	5.68
P3	Non-Panchang sowing	—	12.20	0.00	12.89	87.11	10086	30805	20719	3.05
P4	Non-Panchang sowing	Matka khad@100	16.80	1.64	13.35	85.01	9738	42420	32683	4.36
P5	Non-Panchang sowing	Homabhasam @ 2	15.20	1.58	13.36	85.06	9732	38380	28648	3.94
P6	Non-Panchang sowing	Homabhasam @ 2+ Matka khad @100	19.52	3.24	13.41	83.35	9691	49288	39597	5.09
P7	Non-Panchang sowing+ FYM @ 20 t/ha	—	10.50	49.93	6.49	43.58	20026	26513	6487	1.32

Note: Other charges include seed cost, tractor charges, irrigation charges and interest @ 10% on working capital.
*Best practice.

further be observed that the total variable cost for soybean production did not exceed Rs 10,000 per hectare for practices P1 to P6 but it was almost double under P7 which was only because of the use of FYM in this practice.

The highest grain yield was (20.40 q/ha) obtained with P2 (Panchang sowing along with Homabhasam + Matka khad spray) followed by P6 (Non-Panchang sowing along with Homabhasam + Matka khad spray) and it was lowest for P7 (that is, Non-Panchang sowing with FYM but no use of biosprays). The yield was lowest and costs were highest for P7 thus, resulting in the minimum gross returns, net returns and input–output ratio for this practice. Highest gross returns were realized under P2 followed by P6. These practices occupied the same ranking with respect to net returns and input–output ratio. Therefore, it was revealed that Panchang sowing with application of Homabhasam and Matka khad proved to be the best practice. Similar results were reported by Reganold et al. (1993, p. 344). They opined that biodynamic farms had better soil quality than conventional farms and fetched better returns on per hectare basis.

Cost and return structure for pea with different organic practices

Three practices were used for pea production on organic farm (Table 6). Among composts FYM, vermicompost and Nadep compost were used while Neemastra was used as biospray. The total variable cost was highest (Rs 45,517) for P3 where both vermicompost and Nadep compost were used. It was lowest for P2 where only FYM was used among composts. As in other crops, again the cost of organic inputs constituted the major part followed by human labor.

It can be observed from the table that the highest grain yield (25.20 q/ha) was realized with P2 (FYM @ 15 t/ha + VC @ 5 t/ha). The highest gross as well as the net returns were obtained from P2. But, the input-output ratio turned out to be maximum for P1 because the cost incurred for this practice was comparatively lower than P2. Thus, P1 was found to be the best practice for pea. Schmutz et al. (2007, p. 2791) established that vegetables were among the most profitable enterprises in organic farming.

Conclusions and policy implications

Organic farming is being strongly advocated as a sustainable alternative world over to produce safe, intoxic, unpolluted food economically with sufficient production to meet the requirements of increasing population. But, there exists a gap in the knowledge about the profitability of various organic practices and their combinations that can be used for different crops. To abridge this gap, the present study was conducted on the model organic research farm of CSK HPKV, Palampur. The farm was having 2.66 hectares of net cultivated area. During 2008–09, the cropping pattern was dominated by cereal crops (35%) followed by fodder and oilseed crops. Cropping intensity realized on the farm was about 176%.

It can be concluded from the study that the cost of preparation of different organic composts was comparatively lower than their market prices. Also, the variable inputs accounted for more than 90% of the total costs incurred for preparation of these composts and capital investment was only upto 10%. Therefore, these composts can be prepared by the farmers and used for the enhanced and sustainable production on their farms. Intercropping with soybean proved to be one of the best propositions for maize along with the use of varied quantities of FYM, BD

Table 6: Economics of different organic practices used in pea

Organic practice			Yield (q/ha)	Variale cost			Returns (Rs/ha)			Input-Output Ratio
				Cost components %			Total (Rs/ha)	Gross returns	Net returns	
No.	Compost	Biospray (liter)		Organic inputs	Human labor	Other charges				
P1	Panchang sowing	Homabhasam @ 2	22.40	45.83	33.82	20.35	22178	119840	97662	5.40
P2	Panchang sowing	Homabhasam @ 2+ Matka khad@100	25.20	59.02	24.00	16.97	29165	134820	105655	4.62
P3	Non-Panchang sowing	—	21.33	72.43	15.82	11.76	45517	114116	68599	2.51

Note: Other charges include seed cost, tractor charges, irrigation charges and interest @ 10% on working capital.
*Best practice.

compost and vermicompost. Similarly, in case of wheat, maximum net returns were obtained with the use of FYM and BD composts and spray of compost tea, cow urine, vermiwash, and fermented butter milk.

For soybean, highest yields and net returns were obtained under Panchang sowing with application of Homabhasam and Matka khad. Thus, the productivity of different crops can be sustained by the regular use of these organic practices.

The following policy implications emerged out from this study to strengthen organic farming:

1. Efforts need to be directed toward production of sufficient intermediate inputs/biomass and upscale animal component so as to produce sufficient quantity of organic composts for patronizing best organic practices. The farmers should be trained to produce the organic inputs on their farms so as to promote organic farming in Himachal Pradesh.
2. More emphasis needs to be laid on production of nutrient enriched Biodynamic composts and biosprays. These composts require less quantity of cow dung. Thus, even with lesser animals sufficient quantity of nutrient rich composts can be produced.
3. The most profitable organic practices identified in the study should be included in the package of practices and farmers should be made aware of best organic practices.
4. The remunerative prices for organically produced commodities form the major driving force to promote organic farming in Himachal Pradesh. However, local markets are underdeveloped and certification system is not in proper shape. Hence, efforts should be put in place for developing organic certification. In the light of booming organic markets, there is a need to promote organized marketing system within and outside the state. The producers' cooperatives should be promoted for organized production and efficient marketing of organic produce.
5. Organic farming is a specialized and labor intensive avocation. It requires more knowledge and management skill than conventional farming. Therefore, there is a need to start professional diploma courses to train entrepreneurs/farmers to take up organic farming as a commercial venture.

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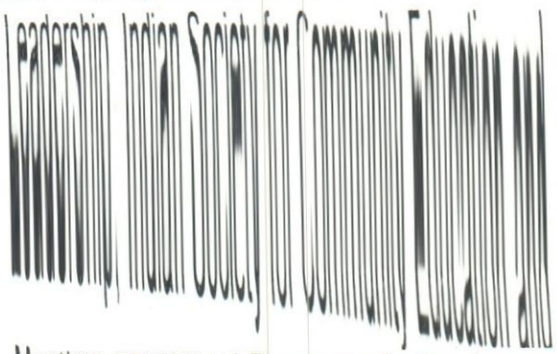

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We must adjust to changing times and still hold to unchanging principles.

—Jimmy Carter

Feature

Scope for Warehouse Receipts Financing of Commodity Markets in India

S.R. ASOKAN AND ANITA ARYA

Spanning from nationalization of banks to financing self-help groups by way of micro financining, numerous innovations have taken place in the field of agriculture and rural finance in India. They majorly focus on concentrated on the production financing aspect, thereby neglecting an equally important marketing finance. This lack slows down the farmers' ability to realize optimal prices for their crops. Here, warehouse receipt financing has been of great help in bringing liquidity to marketing of agricultural goods.

In order to ensure an efficient warehouse financing system, the government of India had enacted the Warehouse Development and Regulation Act, 2007. Under this act, the warehousing development and regulatory authority would be established. Four crops—wheat, soybean, potato, and castor seed—were taken to understand whether the warehouse receipt financing system can be beneficial to the farmers. The variations in price in the inter-cropping season and the cost of carry, that is, interest on the loan and the storage cost were calculated to arrive at the potential net benefit.

It was found that the net benefit to the farmer through warehouse financing was negligible in case of wheat and soybean. It was found substantial for potato. Further, the system is considered to be more beneficial for bigger farmers who have higher marketable surplus.

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Right from nationalization of banks and the emphasis on priority sector lending to financing self-help groups through micro finance, many innovations had taken place in agriculture and rural finance in India. However, the efforts mainly concentrated on production financing and neglected, to a large extent, the equally important marketing finance. A good marketing system facilitates easier financing and a good financing system improves efficiency in marketing (Naik, 2009). Warehouse receipt financing can help a great deal in bringing liquidity to marketing of agricultural goods.

Warehouse receipts are documents issued against the deposit of the commodities in the warehouses. When these receipts are backed by legal provisions to ensure quality and safety of the stocks stored they can be used as collateral. These receipts can be pledged to raise money, sold, or transferred. Generally, farmers face two problems—bulky cash flows at the time of harvest and non-availability of intermediate finance. Lack of adequate post-production financing impedes the ability of farmers to realize optimal prices for their crops. Warehouse receipt finance can play an important role in smoothening income for farmers by providing liquidity at times when cash flows dry out (Mor and Fernandes, 2009).

Agricultural Marketing and Finance

Farmers in India generally dispose of the crops immediately after harvest. Prices are normally low when the supply is high. Farmers have to resort to immediate post-harvest sales as they have no holding capacity. They cannot hold on to the harvested crop as they need immediate cash to pay back the loans raised to cultivate the crop and as well as to meet their household expenses. Further, most of the farmers lack storage space with them. This twin handicap prevents them from taking advantage

of a better price that may prevail few months down the line. Warehouse receipts provide farmers with an instrument that allows them to manage their liquidity requirement by extending the selling well beyond the harvesting period. This helps in preventing the farmers from resorting to distress sales.

How does the warehouse receipt financing system operate? The warehouse receipt financing operates with some variations in different countries. However, it essentially has the following mechanics. After harvest, the farmer deposits his crop in an accredited warehouse and receives a receipt of the stock stored. The warehouse promises secure and safe storage. The warehouse will release the stock only on production of the receipt. The farmer can then approach a bank to raise a loan by pledging the warehouse receipt. The bank gives the loan based on the current market valuation of the crop. Usually it will lend upto a certain percentage of the value of the crop deposited, for example, may be upto 80%. The period of the loan is related to the annual price pattern the borrower is required to repay before the time when prices normally pass their seasonal peak. The bank places a lien on the commodity so that it cannot be sold without the proceeds first going to repay the loan outstanding.

Farmer can, in consultation with the bank, sell the stocks when the prices are favorable and pay back the loan with interest. The farmer, instead of taking out the physical stock to sell, simply hands over the receipt to the trader or processor who made the purchase. The buyer can take delivery of the commodity by paying storage fees loan principal and interest that are deducted before delivery is made. The lender/bank can dispose of the commodity/pledged goods only if the borrower defaults on the loan. Otherwise, the title and any changes in the value of the deposited commodity belong to the depositor/borrower.

As it is clear from the above description there are three parties involved in the process. First, the borrower, that is, the farmer who uses the produce as a security for a loan. Second, the bank, which treats the produce as collateral. The bank has several advantages in lending this way. Warehouse receipts' liquidity is much higher than conventional collateral, such as land and machinery, which are difficult to enforce and hence, provides banks and financiers with the comfort to lend to the farmer without lengthy documentation and long processing delays. Third, the warehouse operator who maintains the produce in good condition and assures the bank that the collateral is secure. Apart from collecting the rent for storage, the warehouse owner collects insurance fee to guard against fire or unusual weather conditions to offset any losses in terms of quality and quantity of stored commodities. So, empowering farmers to hold on to the produce would need three enablers: *(i)* accredited warehouses in the vicinity; *(ii)* commercially acceptable grading and assaying standards; and *(iii)* ease of raising liquidity against commodities stored in the warehouses.

The whole process of warehouse receipt financing can be depicted as in Figure 1.

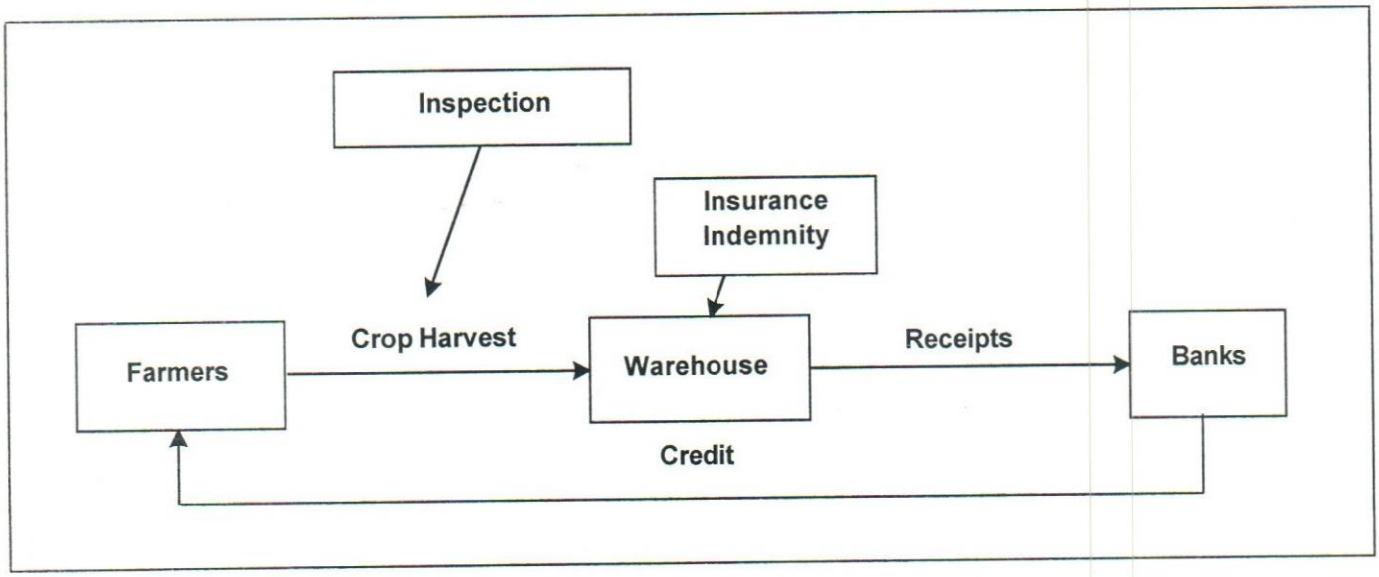


Figure 1. Mechanics of warehouse receipt financing

The farmers can also use future trading for the purpose. Here, the farmers can book a short (sell) contract in the commodity exchange for a future price. The collateral management companies such as National Collateral Management Limited have accredited warehouses which are electronically connected to the central hub which enables the stock position to be updated on real time. The collateral management company issues a dematerialized (demat) warehouse receipt to the farmer through the warehouse where he has deposited his crop. The farmer then approaches a bank for loan against the electronic warehouse receipt. The collateral management company electronically updates all information of the warehouses to the bank, thus also decreasing the risk attached to the loan issued against the pledged warehouse receipt.

As it is clear from the above description, the warehouse receipt is the instrument which is piedged/ traded in lieu of the fundamental assets. Warehouse receipts are functionally equivalent to stored commodities. As the whole transaction takes place without the physical verification of the stocks by the bank or the processor, the assurance about the quality and quantity of the goods mentioned in the warehouse receipt is of utmost importance to the entire process of making the warehouse receipt negotiable. The integrity of the warehouses needs to be ensured by licensing or accreditation to carry out the activity. The rights, liabilities, and duties for each party to a warehouse receipt (producer, bank warehouse, etc.) must be clearly defined. Ideally, the receipt should be freely transferable by delivery and endorsement. Holders of receipts must have the right to receive stored goods or their fungible equivalent if the warehouse defaults or its business is liquidated and the lender should be able to determine before granting the loan if there is a competing claim (Demele, Varangis, and Larson).

Warehouse Receipts in India

In India, Agricultural Produce (Development & Warehousing) Act, 1956 was enacted, later repealed and replaced by Warehousing Corporations Act, 1962. Central & State Warehousing Corporations were established under this act. Private sector initiative on warehousing was limited. Warehouse receipts were issued by a warehouseman to any person depositing goods in the warehouse. The licensed warehouseman was authorized to issue a negotiable or a non-negotiable warehouse receipt. Banks did have a facility for lending against commodities. However, this potential has never been realized in the Indian context as lending against commodities was considered to be risky. Further, the banks were not internally equipped to evaluate the goods stored in the warehouse and was uncertain of the quantity and quality of the goods lodged therein (Ravikumar, 2005).

The warehousing receipts in vogue did not enjoy the fiduciary trust of depositors and banks. There was fear of not being able to recover the loans in events, such as fraud, or mismanagement on behalf of the warehouse or insolvency. The available legal remedies were also time consuming and inadequate. Further, the format of warehouse receipts used in the country was not uniform. Hence, there were impediments in the negotiability of warehouse receipts creating difficulties to the farmers and other depositors of goods.

In order to ensure an efficient warehouse financing system, the government of India had enacted the Warehouse Development and Regulation Act (WDRA), 2007. Under this act, the warehousing development and regulatory authority would be established. (It has been established in 2010). The authority is in charge of certification or registration of warehouses and renews, modify, withdraw, suspend or cancel such registrations. The authority regulates the registration and functioning of accreditation agencies which grant accreditation to warehouses. It regulates the process of pledge, creation of charges and enforcement in respect of goods deposited with the warehouse. It specifies the duties and responsibilities of the warehouse. WDRA regulates the rates, terms and conditions that are offered by the warehousemen. It ensures a fair dispute settlement between warehouses and warehouse receipt holders and ensures minimum percentage of space for storage of agricultural commodities in a registered warehouse. Further, the grades and standards to be followed for different crops that are to be stored are specified in the act. In short, the act has put in place proper measures to ensure the negotiability of the warehouse receipts.

Scope for Warehouse Receipt Financing

Warehouse receipt financing is beneficial to the farmers only when the expected rise in the value of its stored product is actually more than the cost of storage plus that of the borrowed funds (that is, loan principal plus interest payments, bank fees, etc.). For the option of delayed sale to be attractive, there must be general price increase after the harvest season which will make it possible to cover the additional cost of storage.

Price information is essential for decision making. Farmers need to assess when is the best time to sell, financial institutions need to assess the market value of the security, and processor should be able to assess the value of buying the crops at a particular time and quality. Therefore, correct and timely information dissemination of prices s important.

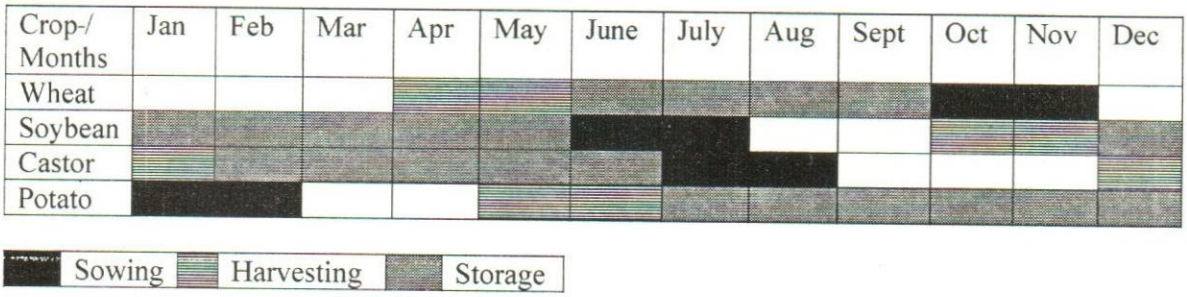
In order to understand whether it would be beneficial for the farmer to hold the stock, one has to look into several factors involving income and cost. First, the price variations of the crop between two seasons have to be examined, that is, the variation in prices from the harvesting period of one year to the sowing period of the subsequent year. The prices prevailing in the inter-cropping season are important because any loan given against the warehouse receipt has to be repaid before sowing in the next season. It helps the banks determine the loan amount for the crop for that harvest season as the sowing acreage and arrival in the subsequent year have a bearing on the price about which

Table 1: Year-wise Price Variation for the Selected Crops in the Important *Mandies*

	Wheat (Khanna, Punjab)				Potato (Agra, U.P.)			
	2008–09		2009–10		2008–09		2009–10	
	Low	High	Low	High	Low	High	Low	High
Jan	1,015	1,050	1,250	1,400	310	400	175	175
Feb	1,035	1,070	1,230	1,300	300	325	250	325
Mar	1,040	1,050	1,110	1,265	300	400	350	500
Apr	1,050	1,080	1,100	1,115	250	325	535	670
May	1,080	1,080	1,105	1,115	300	340	672	725
June	1,080	1,085	1,105	1,150	300	360	675	850
July	1,080	1,080	1,110	1,165	290	350	810	860
Aug	1,085	1,085	1,155	1,165	290	305	965	1,000
Sep	1,055	1,105	1,165	1,165	315	340	960	1,160
Oct	1,100	1,305	1,140	1,210	300	350	1,180	1,225
Nov	1,310	1,340	1,160	1,200	275	335	980	1,300
Dec	1,250	1,310	1,175	1,190	170	235	800	950
	Soybean (Indore, M.P.)				Castor Seed (Kadi, Gujrat)			
	2008–09		2009–10		2008–09		2009–10	
	Low	High	Low	High	Low	High	Low	High
Jan	1,916	2,300	1,870	2,300	2075	2450	2680	2800
Feb	2,136	2,375	1,875	2,171	2,000	2,250	2,215	2,830
Mar	2,000	2,300	1,937	2,030	2,225	2,225	2,750	2,900
Apr	2,450	2,500	1,840	1,965	2,185	2,220	2,850	3,010
May	2,500	2,611	1,840	1,900	2,300	2,380	3,025	3,150
June	2,251	2,480	1,780	1,940	2,305	2,355	3,075	3,525
July	2,217	2,170	1,800	1,990	2,350	2,390	3,450	3,600
Aug	2,080	2,280	1,940	2,050	2,425	2,715	3,480	3,675
Sep	1,880	2,110	1,800	1,980	2,575	2,675	3,740	4,100
Oct	1,850	2,050	1,800	2,100	2,490	2,670	3,300	3,715
Nov	2,180	2,360	2,000	2,210	2,655	2,990	3,600	3,870
Dec	2,240	2,370	1,990	2,150	2,740	2,960	3,800	4,000

Source: agmarknet.nic.in

Table 2: Sowing and Harvesting Periods for Different Crops



the banks would not have any information for determining the ceiling on the loan amount.

The yield of the crop multiplied by the highest price prevailing in any month in the inter-cropping season between two years is taken as the potential the farmer could have earned by holding back the stock for the period.

The cost of carry, that is, the cost of holding the harvested crop till a favorable price is set, include storage fee (including insurance) to the warehouse, the interest on the loan amount, and transport cost to the warehouse.

The difference between the lowest price and the highest price of the crop in the inter-cropping season is the gross benefit that might have accrued to the farmer by holding the stock. The gross benefit minus the cost of carry gives the net benefit. If it is positive, the warehouse receipt financing system is beneficial to the farmer but if it is negative, there is no reason for the farmer to wait for favorable prices.

We have taken four crops—wheat, soybean, potato, and castor seed—to understand whether the warehouse receipt financing system can be beneficial to the farmers. These crops were chosen as they are/were traded in the future market, such as, NCDEX and MCX. The future contract for these crops mentions the place of delivery and the accredited warehouses. The location of the warehouses and the *mandi* prices nearest to them were collected. The *mandi*es and prices for the selected crops are given in Table 1. Month-wise average high and low prices are collected for three years to show the inter-crop season's variation.

The depositors of the commodity, that is, the farmer, have to pay the interest on the loan at the rate of 8% per annum (this rate is charged by State Bank of India on warehouse receipt till March 2010).[1] The cost of storage (other than potato) of the state warehousing corporation Gujarat is used as proxy. For potato, the charges of private cold storages were collected.

The farmer had to take his crop to the *mandi* for immediate sale or warehouse for storage. The transport cost is assumed to be the same in both cases and hence the cost on transport is not included while calculating the cost of cultivation.

Table 2 shows the sowing and harvesting period of the selected crops. Wheat is sown in October– November and harvested in April–May. The price of wheat prevailing from April of the year till October of the year is taken to understand the variation. Similarly, the price of other crops prevailing between harvest time and beginning of sowing

Table 3: Price Variation (high and low) in the Inter-cropping Season and the Potential Income for One Acre and the Difference at the Two Price Points

Crop	Yield (acre)	Price (per qtl)				Potential Income (Rs per acre)				Difference (Rs per acre)	
		2008		2009		2008		2009		2008	2009
		Low	High	Low	High	Low	High	Low	High		
Wheat	17.25	1,040	1,305	1,100	1,210	17,940	22,511.25	18,975	20,872.5	4,571.25	1,897.5
Soybean	4.4	1,916	2,611	1,840	2,300	8,430.4	11,488.4	8,096	10,120	3,058	2,024
Potato	87.6	170	350	800	1,300	14,892	30,660	70,080	1,13,880	15,768	43,800
Castor	7.7	2,000	2,380	2,215	3,525	15,400	18,326	17,055.5	27,142.5	2,926	10,087

Table 4: Cost of Holding the Crop and the Net Benefit

Bank Loan*		Bank Rate**		Storage Cost	Net Benefit	
2008	2009	2008	2009		2008	2009
14,352	15,180	574.08	607.2	890	3,107.17	400.3
6,744.32	6,476.8	269.77	259.07	100	2,688.22	1,664.92
11,913.6	56,064	476.54	2,242.56	7,884	7,407.45	33,673.44
12,320	13,644.4	492.8	545.77	175	2258.2	9,366.22

*@ 80% of lowest price
** @8% per annum

in the subsequent season is examined. These prices are important because any loan on the warehouse receipt need to be repaid before sowing in the next season. As mentioned earlier, it helps the banks in determining the loan amount for that harvest season. The price of wheat was 1,305 per quintal, highest in the period 2008–09 and Rs 1, 210 during 2009–10. The lowest prices were Rs 1,040 for 2008–09 and Rs 1,100 for 2009–10. The highest and lowest prices for all selected crops prevailing between harvests and before subsequent year's sowing is presented in Table 3.

The yield of the crop multiplied by the highest and lowest price prevailing in the inter-cropping period of one season to other is calculated. The difference between the two is the potential benefit the farmer could enjoy in case he could hold the stock till the prices are favorable. Table 3 gives the details of the calculation. Assuming the bank gives loan to the tune of 80% on the lowest price interest to be paid by the farmer is calculated.

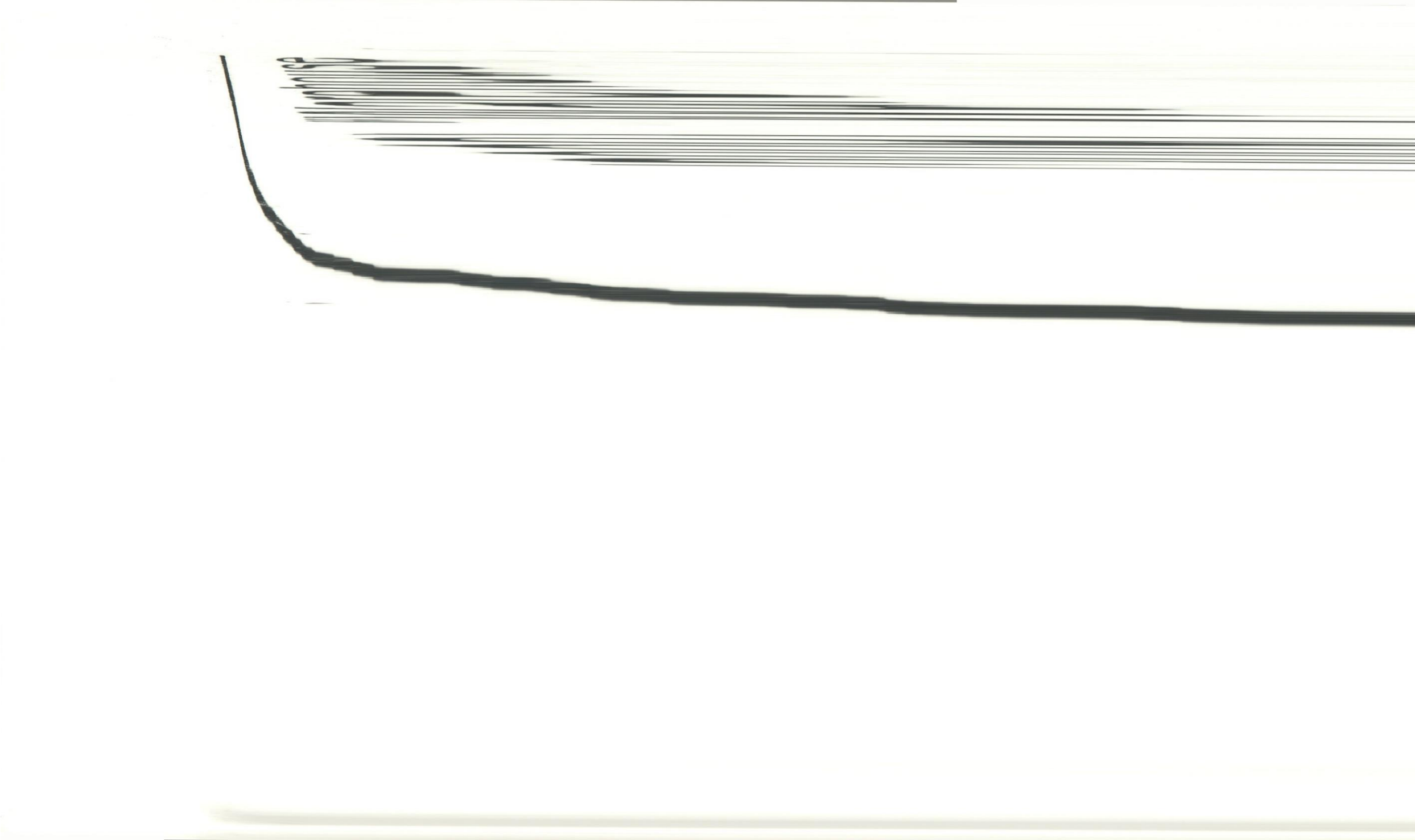
As it is clear (Table 4), the net benefits to the farmers in case of wheat and soybean is very small and is not attractive for the farmers to store and use warehouse receipt to raise finance. We have taken the calculation for one acre of crop for bigger farmers who have higher marketable surplus it may be advantageous.

Government intervention in agricultural marketing is all pervasive and reduces incentives for storage as the prices may not be allowed to rise beyond certain levels. This is inevitable most of the times especially for food grains to support the public distribution system. As it is evident from our analysis, the gains for the farmers in case of wheat is barely above the cost of carry, that is, interest and rent. Therefore, the attractiveness of warehouse receipt finance is limited in these crops.

However, the potential benefits for warehouse receipt finance is quite substantial in crops like potato. It is Rs 7,400 and Rs 33,600 per acre for the years 2008–09 and 2009–10, respectively. This is a substantial gain compared to immediate disposal of the crop.

The gains to the farmer may be more if they are linked to future contract. The farmer can hedge his stock for a future price by determining the receipt he can benefit. This needs to be encouraged along with warehouse receipt in order to ensure meaningful gains to the farmers. However, as the marketable surplus is small and the future contract size is normally large (one contract for potatoes in MCX is for 30 tons) it is not possible for the small farmers to participate in the future. Further, the mechanics of trading in the future and nuances are not easily understood. Hence, farmers need to aggregate the crops to meet the contract size. The aggregator could be a cooperative or producer company of the farmers who will trade on behalf of the farmer. Otherwise, this option is limited to the big farmers, traders, and processors and thus the potential of the warehouse receipt for the post-harvest credit may not be fully realized.

To sum up, the scope for warehouse receipt financing is limited in case of foodgrains such as wheat is limited as the variation in price is small. However, there are substantial benefits to the farmers in other crops hence the scope for the warehouse receipt financing is pretty good in these crops.



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The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard."

—Gaylord Nelson

Feature

Public–Private Partnerships and Electronic Toll Collection-Means to Improve the Operational Efficiency of Freight Transportation by Road in India

SUBRATA MITRA

To cope with the increasing passenger and freight traffic volumes, the government has undertaken massive investment programs in road development and maintenance. To meet the investment target, the government has sought private participation in public projects in the form of public–private partnerships. Also, one way of financing road development and maintenance programs is by means of collecting user fees or tolls on highways. Presently, the majority of the toll plazas in India collect tolls manually. This article discusses how more private participation in public projects and the introduction of electronic toll collection will lead to timely completions of projects, enhance road quality, increase vehicle throughput and freight transportation efficiency, and reduce congestions, delays, accidents, break-downs, fuel consumptions and environmental pollution.

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India has been experiencing a near double-digit growth for the past few years, second only to China in terms of the growth rate. However, Indian roads have not been able to cope with the growths in passenger and freight traffic volumes. First, roads are inadequate in length. Second, most of the roads are of poor quality, and finally, there are numerous mandatory stoppages en route to a destination leading to congestions, delays, accidents, and frequent breakdowns. To overcome these problems, the Government of India (GOI) has undertaken a massive road development program that involves huge financial outlays over a number of years. The scale of required investments makes it onerous for the GOI to finance of its own. Therefore, private participation in public projects has been sought, and one way of financing road development and maintenance programmes is through the collection of user fees or tolls. This article discusses how the operational efficiency of freight transportation by road in India may be improved by means of public–private partnerships and electronic, instead of manual, toll collection. Comparisons with other countries have been made wherever applicable.

India's Road Network

Roads are the lifeline of a country's economy, carrying passengers and freight from one end of the country to another. India has the second largest road network in the world. The total length of roads has increased over 10 times from 0.4 million km in 1950–51 to 4.24 million km in 2010–11. While the United States tops the list with 6.5 million km of road network, China lags behind India with 3.7 million km of roads. As far as the density of roads is

concerned, India with 1.29 km of roads for every square km of area is among the top in the world. Table 1 shows the total road lengths and road densities for the United States, India, China, and Brazil. The last column indicates the latest year for which data are available for a particular country.

Table 1: Road lengths and road densities for the United States, India, China, and Brazil

Country	Road length (million km)	Road density (km/sq. km)	Year
United States	6.5	0.68	2009
India	4.24	1.29	2010
China	3.7	0.39	2008
Brazil	1.75	0.21	2004

Source: World Bank (http://www.worldbank.org)
Ministry of Road Transport and Highways, GOI (http://www.morth.nic.in)
Bureau of Transportation Statistics, Govt. of U.S. (http://www.bts.gov)

Indian roads can be broadly classified into four categories—(a) National highways/Expressways, (b) State highways, (c) Major district roads, and (d) Rural roads. While national highways and expressways connect important cities and towns of different states across the country, state highways and major district roads connect cities, towns and rural roads within a state with the national highway network. Table 2 shows the lengths of different categories of highways/roads and the corresponding percentages of the total road network.

Table 2: Lengths and percentages of different categories of highways/roads

Category of highway/road	Length (km)	Percentage of total road network
National highways/ expressways	70,934	1.67
State highways	154,522	3.65
Major district roads	2,577,396	60.84
Rural roads	1,433,577	33.84

Source:Ministry of Road Transport and Highways, GOI (http://www.morth.nic.in)

Table 3 shows the percentages of paved roads and national highways/expressways for the United States, China, and India.

Table 3: Percentages of paved roads and national highways/ expressways for the United States, China, and India

Country	Percentage of paved roads	Percentage of national highways/ expressways
United States	67.4	4.13
China	53.5	2
India	49.3	1.67

Source: Ministry of Road Transport and Highways, GOI (http://www.morth.nic.in)
World Bank (http://www.worldbank.org)
Note: Data related to the percentages of paved roads pertain to the year 2008

It is observed from Table 3 that although India has the second largest road network in the world, it is still behind the United States and China with respect to the percentages of paved roads and national highways/ expressways. India's national highways constitute only 1.67% of the total road network, but they carry 40% of the road traffic. National and state highways constitute less than 6% of the total road network, but they account for almost 80% of the road traffic. Out of 70,934 km of national highways/expressways, 17,752 km (25%) is single lane/ intermediate lane, 36,995 km (52%) is double lane, and 16,187 km (23%) is four/six/eight lane. The shortage of multi-lane highways coupled with poor road conditions and stoppage delays cause congestions, accidents, breakdowns, and high maintenance costs of roads and vehicles. A vehicle on Indian roads can clock an average speed of only 20–25 km per hour covering 250–400 km in a day whereas in other developed countries, a vehicle can cover 700–800 km in a day. Vehicles in India cover only 80,000–100,000 km in a year while in the United States, vehicles cover up to 400,000 km in a year. The conditions of rural roads are even poorer. 40% of Indian villages do not have access to all-weather roads and are cut off during the monsoons. The problem is more acute for the north-eastern states, which are poorly connected with the rest of the country. Urban road networks, on the other hand, are inadequate creating congestions and limiting vehicular speeds to 10–15 km per hour during rush hours.

Freight Transportation by Road

In India, about 60% of the freight by volume is carried by roads, the remaining being carried by the railways, waterways, and airlines. While the transport sector contributes about 6.6% to India's GDP, the contribution of road transportation alone is about 4.7%. Therefore, considering India's GDP of US$1727.11 billion in 2010, the contribution of road transportation is US$81.17 billion. Road freight volumes are expected to increase from 6 billion tonne km (BTKM), about 14% of total freight volumes, in 1950–51 to 1315 BTKM (projected), about 60% of total freight volumes, in 2012–13, registering a compounded annual growth rate (CAGR) of 9.08%. India's GDP, on the other hand, has increased from US$20 billion in 1950–51 to US$1727.11 billion in 2010–11, registering a CAGR of 7.71%. Therefore, it is observed that the growth in road freight volumes has outpaced the growth in GDP, signifying the contribution of freight transportation by roads to GDP. The vehicle (all types) population also grew from 306,000 in 1950–51 to about 115 million in 2008–09 at a CAGR of 10.76%. The population of goods vehicles increased from 82,000 to 6.04 million during the same period at a CAGR of 7.7%. The share of goods vehicles in all types of vehicles decreased from 26.8% to 5.25% indicating higher growths of passenger vehicles including two-wheelers and four-wheelers. However, during the period 1950–51/2010–11, the total road network increased from 0.4 million km to 4.24 million km registering a CAGR of only 4.01%. The CAGR of national highways is even lower at 2.2%. Therefore, the growth in road lengths has not been commensurate with the growths in road freight volumes and vehicular traffic. Table 4 shows the growths in GDP, road freight volumes, vehicles and road lengths. The figures in brackets indicate the years for which the data are relevant.

Table 4: Growths in GDP, road freight volumes, vehicles, and road lengths

GDP/Freight/ Vehicle/Road	Unit	1950-51	2008-09 2010-11 2012-13	CAGR (%)
GDP	US$ billion	20	1727.11 (2010–11)	7.71
Road freight volumes	BTKM	6	1315 (2012–13)	9.08
Vehicles (All types)	Million	0.306	115 (2008–09)	10.76
Vehicles (Goods)	Million	0.082	6.04 (2008–09)	7.7
Road lengths	Million km	0.4	4.24 (2010–11)	4.01

Source: Ministry of Road Transport and Highways, GOI (http://www.morth.nic.in)
World Bank (http://www.worldbank.org)

Freight movement in India heavily depends on roads, which account for about 60% of total freight volumes, while in the United States and China roads carry about 37% and 22%, respectively, of total freight volumes where railways also carry a significant portion of freight. Although India has one of the highest road densities in the world, the growth in roads has not been able to match the growths in freight and vehicles, leading to congestions, long delays and substantial costs to the environment and the economy. It is estimated that an additional 4 million vehicles will be required to carry the projected road freight volume of 1315 BTKM in 2012–13. Therefore, new roads should be built, the national highway network should be extended, and national highways/expressways should be multi-laned at a faster pace.

Road Development Programmes and Financial Outlays

The Ministry of Road Transport and Highways of the GOI is responsible for highways development, maintenance, regulations, and safety. Massive highway development projects under the National Highways Development Project (NHDP) implemented by the National Highways Authority of India (NHAI) have been undertaken that would oversee the completion and widening of the 5846-km long Golden Quadrilateral (GQ) connecting the four major metros, Kolkata, Delhi, Mumbai, and Chennai, and the 7142-km long North-South, East-West corridors connecting Srinagar with Kanyakumari and Silchar with Porbandar at an estimated cost of Rs. 65,000 crore at 2004 prices. Other projects undertaken by NHDP are the upgradation and four/six/eight laning of national highways, construction of ring roads and bypasses in major towns and construction of flyovers, elevated roads, tunnels, underpasses etc.

It has been estimated that approximately Rs. 221,758 crore would be required as financial outlays for developing and maintaining national and state highways during the 11th Five Year Plan (2007–12), the breakup being Rs. 121,758 crore and Rs. 100,000 crore for national and state highways, respectively. It has also been estimated that a massive program for development of highways under NHDP is required to be completed during the period 2005–15 with an investment of Rs. 235,690 crore in a phased manner. A McKinsey & Company report

estimates that road spend is going to touch US$250 billion between 2008 and 2020 based on current trends.

Funding for road development and maintenance comes from budgetary support (including tax-free infrastructure bonds and borrowings from World Bank, Asian Development Bank, Japan Bank for International Cooperation, etc.) and various forms of taxes such as tax collected on vehicle purchase, vehicle registration fees, road tax, road permit fees, tax collected at inter-state check posts and by local authorities, highway tolls, cess on fuel, etc. The GOI has created a Central Road Fund (CRF) with Rs. 2 per liter collection of cess on petrol and high-speed diesel oil for development, maintenance, and safety of national highways, state roads, rural roads and railway over/under bridges. However, budgetary support including borrowings, taxes and surcharges, and fees collected against services are not adequate for funding the massive investments required for roads. In the budget for the financial year 2011–12, a plan expenditure of Rs. 20,000 crore has been provisioned for roads and highways, well short of the required total financial outlays. Therefore, private participation in the form of public–private partnerships (PPP) has become inevitable for the development and maintenance of roads, bridges, flyovers and tunnels.

Public–Private Partnerships in Road Projects

Traditionally, development and maintenance of roads have been the sole responsibility of the government. However, the massive road development program undertaken by the government necessitated the revision of the National Highways Act of 1956 to encourage private sector participation in road development projects in the PPP mode allowing them to build, operate and maintain roads, and collect and retain fees. The primary advantages of involving the private sector are the following—no overheads for the government, greater efficiency, better quality, flexible procurement and decision-making procedures, no cost overrun and early completion of projects. Some of the state governments have also adopted the PPP approach for the development of roads in their states. However, there are some concerns regarding private participation. Since financing is the sole responsibility of the private concessionaire, the quantum of capital investments is a cause for concern. Also, when user fees are to be collected by the private concessionaire, the quantum of fees that can be charged as per government rules and the lack of accurate information on the volume of traffic flows make revenue predictions highly uncertain. To address these concerns and facilitate private investments in roads, the Government has announced several incentives including declaring the road sector as an industry, allowing 100% foreign direct investments, taking responsibilities of land acquisition, feasibility studies, environmental clearance, cutting of trees and shifting of utilities, providing subsidies up to 40% of the project cost (Viability Gap Funding or VGF), equity participation up to 30%, soft loans and 100% tax exemption, and waiving of customs duty on the import of modern road construction equipment. Presently, NHAI acts as the regulator. However, in the long run, an independent regulatory authority (like the Telecom Regulatory Authority of India or TRAI) is required to be set up to assess benefits, costs, service levels, safety measures, and the rationality of the tariff structure.

The PPP projects for road development generally fall in the following three categories—(a) Build, Operate and Transfer (BOT) Toll basis: The concessionaire builds, operates and manages the road, and collects and retains user fees (tolls). The ownership of the road is transferred to the government after the concession period (maximum 30 years) is over; (b) Build, Operate and Transfer (BOT) Annuity basis: This is similar to the BOT (Toll) basis except that user fees are collected by the government and the concessionaire receives a fixed annuity payment every year during the concession period, and; (c) Special Purpose Vehicle (SPV) basis: SPVs are separate legal entities in which the Government may have an equity stake. Rest of the capital may have to be raised from other organizations and financial institutions in the form of equities and debt. SPVs have to recover their expenses on road development through the collection of user fees, and when the concession period is over, the ownership is transferred to the Government and SPVs are disbanded.

In the 11th Five Year plan, it is estimated that out of the Rs. 121,758 crore financial outlay for national highways, Rs. 87,735 crore will be invested by the private sector, and out of the Rs. 100,000 crore investment in state highways, Rs. 32,000 crore will come from the private sector. As of November 30, 2011, 149 projects of length 13,791.25 km have been awarded on the BOT (Toll) basis and 29 projects of total length 3,311.42 km have been awarded on the BOT (Annuity) basis. The government has planned that henceforth all NHDP projects will be implemented through the PPP mode. In the next five years, NHDP envisages an investment of US$70 billion with a major share by way of PPP.

Toll Collection and Related Issues

Irrespective of public-funded or PPP projects, toll is collected from users on many segments of national highways to recover the upfront investment and carry on operations and maintenance activities. Collection of toll may be thought of as an alternate source of financing road development and maintenance projects besides taxes and surcharges, thereby relieving the Government of the pressure of making appropriate budgetary provisions. Also, collection of toll is an efficient mode of financing since revenues realized are dedicated to the operations and maintenance of the segment of the highway for which toll is collected, and there is no dependence on the allocation of funds from the common pool of resources, as in the case of collection of taxes and surcharges. Collection of toll is based on the principle—"users pay," that is, only the vehicles that pass through the toll road have to pay toll whereas taxes and surcharges are levied from every vehicle that may or may not pass through the toll road. There are a few other secondary objectives of toll collection such as to reduce road congestions, to encourage the use of public transportation and to cross-subsidize the development of roads in other geographical regions.

Toll rates vary across countries and across different regions within a country. However, there are some common factors based on which toll rates are determined. For example, toll rates are proportional to the length of the toll road, and are dependent on the type of vehicle, the number of axles/tyres, the time of day or day of week, which is also sometimes referred to as congestion pricing, etc. Goods vehicles are normally charged higher toll rates than passenger vehicles. Also toll rates per km for tunnels and bridges are higher than those for roads due to higher per km construction costs and unavailability of alternative routes. Reduced toll rates may be applicable for frequent users and vehicles registered within a certain radius of the toll plaza. In India, toll rates are linked to the Wholesale Price Index (WPI). Indicative toll rates for different types of vehicles are available on the website of the Ministry of Road Transport and Highways, GOI.

Many countries do not have toll roads. Even if a country has toll roads, the length of the toll roads is typically less than 5% of the total road network. China houses more toll roads than any other country with Chinese toll roads representing more than 70% of the world's total toll roads. In the financial year 2009–10, the total length of toll roads in India was 8,502.48 km and toll collection was Rs. 4,363.57 crore. The government is planning to increase the total length of toll roads to 30,000 km in the next five years. In the financial year 2010–11, a total length of 2,871 km of national highways was targeted for tolling and the toll collection target was Rs. 1,500 crore. Up to December, 2010, 849 km of national highways was brought under tolling and Rs. 1410.06 crore was collected as toll.

Toll may be collected in one of the following three ways: (a) manual tolling; (b) mixed tolling, that is, partly manual and partly electronic; and (c) electronic tolling where there is no manual toll collection. Depending on the traffic conditions, manual tolling may cause congestions, long queues, delays, additional fuel consumption, environmental pollution, and leakage through toll avoidance and under-reporting of toll collections. Also, since manual tolling is a slow system, more toll lanes are required than electronic tolling to achieve the same throughput, which may lead to land acquisition problems, especially in densely populated areas, and higher operating costs for the toll operator. According to a CRISIL study, there are about 525 toll plazas operating on national and state highways in India through which more than 20,000 vehicles cross each day, queuing up for approximately 5–10 minutes awaiting their turn to pay the toll. The average delay at a toll plaza is confirmed by the data available for 30 round trips of 15-tonne vehicles on the Delhi–Mumbai route. The average delay on 16 toll plazas on the route was about 160 minutes, which translates into an average delay of 10 minutes per toll plaza. Also, the average total delay (including RTO and Octroi stoppage delays) on the route was about 200 minutes, meaning thereby that delays at toll plazas constituted about 80% of the total stoppage delay. Toll expenses on the same route were also a major contributor to the total stoppage expenses, contributing as high as 86% of the stoppage expenses. Delays lead to additional fuel consumption in terms of slowing down before a toll plaza, idling and picking up speed after crossing the plaza. The CRISIL study estimates that 0.5–1 liter of fuel is consumed per hour at a toll plaza leading to a wastage of Rs. 3–6 crore daily and Rs. 1,000 crore annually. The same study estimates that based on an industry average of 10% leakage, the annual loss to road developers is of the order of Rs. 1,200 crore. In terms of environmental pollution, road transportation is the worst among roads, railways and waterways, contributing 64 gm of CO_2-equivalent greenhouse gases to the environment per tonne-km compared to 28 gm and 15 gm, respectively, for railways and waterways. Therefore, reducing delays at toll plazas would not only reduce additional fuel

consumption, but also reduce emissions to the environment.

Electronic Toll Collection

Electronic toll collection (ETC) that automatically deducts the applicable toll from users' accounts as vehicles cross the toll plaza, may remedy the deficiencies of manual toll collection by allowing users to pass through the toll plaza without stopping, thereby adding to user convenience, saving time, eliminating congestions and long queues, and reducing accidents, additional fuel consumption, and emissions to the environment. On the other hand, toll operators will be benefited by reduced operating costs at toll plazas, maintenance of electronic records and plugging of revenue leakage. According to an estimate of the transportation authorities in the United States, the annual operating cost for a manual toll lane varies from US$150,000 to US$180,000 whereas the annual cost of operating a dedicated ETC lane is less than US$5,000. Also, since ETC is faster than manual tolling, the throughput in terms of the number of vehicles crossing the toll plaza per hour will be higher enabling the toll operator to collect more tolls per hour. There are, of course, some concerns about ETC such as (a) vehicle registration database—information on all registered vehicles, including the account details, eligible for electronic toll collection is to be maintained in a database; (b) communication—communications between the toll plaza and vehicles, and between the toll plaza and the remote server that maintains the vehicle registration and account details are to be up and active on a real-time basis; (c) inter-operability—different toll operators may follow different standards leading to the compatibility issue; (d) a large number of occasional users—the use of ETC is more meaningful when the number of occasional users is small, and; (e) enforcement—since vehicles are not required to stop at toll plazas, proper enforcement laws are to be framed to deal with defaulters, and distinguish between willful evasion and genuine cases. The above-mentioned concerns notwithstanding, ETC has been shown to provide numerous benefits on record such as reducing delays, fuel consumptions, and environmental emissions. For example, the Intelligent Transportation Systems (ITS) of the Department of Transportation, U.S. reported that the New Jersey Turnpike's introduction of ETC saved fuel worth 1.2 million gallons annually across 27 toll plazas, Baltimore reduced environmental emissions by 16–63% at toll plazas that were upgraded to ETC, and the introduction of Open Road Tolling or ORT where vehicles cruise past the toll plaza at near-highway speeds in addition to ETC in Florida helped decrease delay by 50% and increase speed in ETC lanes by 57%.

ETC has been operational in Europe since 1987 and in the United States since 1990. Today, such systems collect more than 50% of all toll revenues, and for some systems, the figure is close to 80%. In the United States, 83% of toll plazas have ETC capabilities and 98% of toll lanes offer ETC. Although ETC continues to develop in the United States and Europe, the biggest growth potential is in Asia (China, India, Thailand, and Australia) and South America (Brazil and Chile), China introduced domestic ETC standards in 2007. In 2008, China started to promote ETC, first with pilot projects in several provinces and regions, and then expanded them to build a national ETC network. Today, the ETC system is available on more than 1,600 highways in China. According to a recent study by Global Industry Analysis, Inc., the global ETC system market is going to reach US$5.9 billion by 2017. The United States, which is the largest market worldwide, is expected to make an investment of US$210 billion in ITS, a substantial portion of which will go into ETC. China, on the other hand, represents the fastest growing market for ETC systems at a CAGR of 20%.

In India, the majority of the toll plazas still operate in the manual mode. ETC is available only in a few highways and bridges such as Delhi-Gurgaon highway, Bangalore-electronic city elevated highway, Noida toll bridge, Delhi-Faridabad skyway, Ahmedabad-Mehsana expressway etc. However, to increase the throughput from 300–500 vehicles per hour to 1200–1800 vehicles per hour, India needs to convert manual toll lanes into ETC lanes. It has been decided that all new road projects are going to be equipped with ETC lanes and manual toll lanes are to be upgraded to ETC lanes. The government plans to introduce ETC by May, 2012.

However, there are some roadblocks to the smooth roll-out of the ETC system in India such as the lack of a computerized vehicle registration database and hence a back-end central data processing centre, cost implications for users and toll operators, inter-operability of different ETC systems and the absence of a regulatory framework for dealing with defaulters. The Ministry of Road Transport and Highways, GOI, vide a notification dated 20 April, 2010, constituted a committee under the chairmanship of Mr Nandan Nilekani, Chairman, Unique Identification Authority of India (UIDAI) to examine all available ETC technologies and recommend the most suitable one for implementation throughout India. The committee submitted

its report to the Ministry on 28 June, 2010. The committee recommended the passive RFID (Radio Frequency Identification) technology, which is not only fast becoming a common and popular standard worldwide, but also less expensive, and less complex, for both users and toll operators. An RFID tag, also known as the On-Board Unit (OBU), which is to be stuck to the windscreen of the vehicle, costs only about Rs. 100, works almost life-long, and is also very small, light and tamper-proof. The Road-Side Unit (RSU) or the reader costs about Rs. 2 lakh, lower than the cost for many other technologies. Another advantage of the recommended technology is that there are multiple vendors, leading to competition and further lowering of prices. The committee emphasized the need for inter-operability among different ETC systems, and noted that unlike in the United States and Europe where inter-operability became an issue since different vendors used different ETC systems, India, like China, could develop a common ETC standard, which could be adopted by different vendors during implementation. The committee provided further recommendations with regard to Automatic Vehicle Identification (AVI) (Each vehicle is assigned a unique id), Automatic Vehicle Classification (AVC) for determining the toll amount based on the type of vehicle, number of axles, etc., setting up a Central Toll Clearing House (CTCH) for accounts maintenance, recharging, debiting the applicable toll amount from the user's account and crediting the toll operator's account, sharing data among multiple toll operators and revenue reconciliation, handling vehicles violating toll conditions with the enforcement of an appropriately designed regulatory framework, and scalability for future applications such as tracking vehicles, paying fines and parking fees, etc. To begin with, the committee suggests, one-half of the lanes at a toll plaza may be made ETC-compliant, gradually moving towards 100% ETC-compliance based on the interim experience. The Ministry accepted all the recommendations made by the committee and set up an Apex Committee to finalize the specifications of the different components of the ETC system, which, vide a resolution dated September 28, 2011, specified the requirements for the RFID transceiver, RFID tag, and data exchange formats between the toll plaza client and the CTCH server.[30] It is, therefore, expected that, as mentioned before, ETC will be operational in India by May, 2012.

Conclusions

Indian roads have not been able to match the growth rates of passenger and freight traffic volumes. The government has undertaken massive road development and maintenance programmes that require substantial investments in the coming years. To meet the required investment, the government has sought private participation in public projects in the form of public-private partnerships. It is expected that more than 50% of the investment will come from the private sector. Also, one way of financing road development and maintenance programs is by collecting user fees or tolls on highways. Presently, the majority of the toll plazas in India deploy the manual mode of toll collection, which is not only slow and inefficient adding to congestions, delays, accidents and revenue leakages, but also leading to additional fuel consumption and environmental pollution. The government has decided that henceforth all new roads will be fitted with electronic toll collection capabilities, and the existing manual tolling systems will be gradually upgraded to electronic tolling systems. The government is planning to introduce electronic toli collection facilities by May, 2012. It is expected that a higher degree of participation of the private sector in road development and maintenance programmes and the introduction of electronic toll collection will not only lead to timely completions of projects, better quality of roads, increased throughput of vehicles and efficient freight transportation, but also reduce congestions, delays, long queues, breakdowns, accidents, additional fuel consumptions, and emissions to the environment.

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Our task is not to make societies safe for globalization, but to make the global system safe for decent societies

—John J. Sweeney

Feature

The Association between Price Reaction and Information Environment of the Firm Surrounding Dividend Initiation Announcements: Further Evidence of Market Inefficiency

HARI OM CHATURVEDI AND PANKAJ MADAN

"Information content of dividends" is now a well-accepted hypothesis. A change in dividend is viewed as an action to convey information to the market regarding future profitability of the firm. Unanticipated information contained in dividend changes trigger price reaction. The magnitude and volatility of price reaction to changes in dividend are related positively to the information content of the dividend announced. However, the amount of information conveyed by a given change in dividend may not be same for all the firms announcing that change; it is related to the information environment of the firm. A large sized, heavily traded firm may have more prior information than a small sized, thinly traded firm. Therefore, a given change in dividend may convey less information for the former than the latter. In this study, highly significant abnormal returns are found to be associated positively with dividend initiation announcements in the pre- and post-announcement periods. Further, the price reaction is stronger for low information environment firms (firms with small capitalization and less percentage of institutional equity holding) than firms with medium/high information environment (firms with large capitalization and more percentage of institutional equity holding). The findings also suggest that the market violates the efficient market hypothesis with respect to dividend initiation announcements.

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According to "The Information Content of Dividends Hypothesis" (Miller and Modigliani, 1961) dividend changes convey information to the market about the firm's future profitability. A number of studies have supported this hypothesis [see for example, Asquith and Mullins (1983), Doron Nissim and Amir Ziv (2001), Venkatesh (1989), Healy and Palepu (1988)]. Changes in dividend is considered as a credible source of information as opposed to the announcements made by firms about their future prospects which are viewed by the market with a great deal of skepticism mainly because firms routinely make exaggerated claims. By increasing dividends, firms commit themselves to paying these in the long term which indicates that they have the belief to generate these cash flows in the long term. Decreasing dividends is viewed as a negative signal because firms are reluctant to cut dividends unless they are in long term financial trouble. Since dividend changes convey unanticipated information with valuation implications, these are positively associated with stock returns in the days surrounding their announcements (Aharony and Swary [1980], Asquith and Mullins [1983], Kalay and Lowenstein [1985], Petit [1972]).

If dividend conveys valuable information to investors, it will induce price changes and increase in volatility both of which should be a function of the information content of the dividend announced. Information content of the dividend announced is the unanticipated information it contains, which will trigger price-reaction and increase in volatility. That is, regular dividend does not convey any new information. At the most, it confirms that the firm expects to maintain its profitability in the future which justifies its current price. Thus, no price correction is needed. Only a

change in dividend conveys new/unanticipated information, which in an efficient market will lead to price reaction.

Though, there is a substantial body of research indicating that dividend changes convey unanticipated information about the firm's future profitability, these findings do not lead us to conclude that a given change in dividend convey same level of unanticipated information for all the firms announcing that change. A large sized, heavily traded firm is monitored widely by the market. Therefore, it will have more publicly available information, than a small firm which is not so closely followed. Announcement of a change in dividend by a not so closely followed firm may convey more information and will have greater valuation implications than a similar announcement by a relatively more closely followed firm.

Substantial increases in volatility in pre- and post-price sensitive information announcement period have been reported (Christie [1983]; Kalay and Lowenstein [1985]; Patell and Wolfson [1979]). This volatility is expected to be associated positively to the magnitude of unanticipated information in the announcement. That is, volatility increase should be more for the less closely followed firm (firm with low information environment) than for the more closely followed firm (firm with high information environment).

This article empirically examines the association between *magnitude* and *volatility* of security price reaction and the firm's information environment in the context of dividend initiation announcements. Information environment of a firm is defined in terms of publicly available information about that firm. Since, information environment of a firm is not directly observable, proxies described in the sub-section, "the information environment proxy measures," are used to represent it. Relative magnitude and volatility of price reaction to the dividend initiation announcements of various information environment (high or low) firms is indicative of the information content of these announcements.

Prior Evidence

The announcement of regular dividend does not contain any unexpected information and hence does not affect price reactions. The rationale is that only surprise element in the reported information cause movement in stock prices as it alters expectations regarding future financial performance of the firm. Thus, it can be argued that the magnitude and volatility of price reaction should be a function of surprise element in the dividend information. In this study, the focus is on dividend initiation announcements since these contain more unexpected information than a regular dividend. A firm initiating dividend has no prior history of paying dividends. Asquith and Mullins (1983) argued that "dividend signalling" effect should be more pronounced at the initiation of dividend than at regular dividend announcements, which more or less can be predicted from the past history of the company. They reported a much higher magnitude and volatility of excess returns at dividend initiation announcements than at regular dividend announcements. Kim and Verrechia (1991) have provided a theoretical reasoning for different price corrections to anticipated vs. unanticipated announcements. Richardson, Sefeik, and Thompson (1986) examined the possible signalling effect of dividend initiation announcements. They concluded that dividend initiation, signals increased future profitability which causes increased volatility. Motivated by their findings, Healy and Palepu (1988) and Venkatesh (1989) further investigated the relationship between dividend initiation and future earnings. On the basis of their analysis of dividend initiation and subsequent earnings growth rate for 151 firms from 1970 to 1979, Healy and Palepu reported that the earnings growth rate increases significantly after dividends are initiated. It confirms that initiation of dividend may operate as positive signal of future earnings growth. Venkatesh compared the information content of quarterly earnings announcements subsequent to dividend initiation (on quarterly basis) and found that the latter conveyed more information than the former. Michaely, Thaler, and Womack (1995) investigated the market reactions to initiations and omissions of cash dividend payments and found that the magnitude of short-run price reactions to omissions is greater than for initiations. McCaffrey and Hamill (2000) examined the market reaction to dividend initiation announcements by Initial Public Offerings (IPOs) in the UK. Using data for 131 Official Listed (OL) and 139 Unlisted Securities Market (USM) firms, covering the period 1982–1991, they found a positive market reaction to such announcements. Dasilas, Lyroudi, and Ginoglou (2009) employed event study methodology to examine the share price reaction to initial dividend announcements across different information environments. Their results show that dividend initiations bring about significant positive abnormal returns in the announcement period. The price response to dividend initiations is inversely associated with the information environment. Finally, the volatility of stock returns is higher in the low information environment group of firms than in the high information environment group of

firms. Recently, Officer (2011) found evidence consistent with the hypothesis that reductions in the agency costs of overinvestment at firms with poor investment opportunities and ample cash flow are reflected in higher dividend initiation announcement returns.

Hypotheses

This article examines the association between the magnitude and volatility of price reaction to dividend initiation announcement in the context of the firm's information environment. It is hypothesized that the magnitude and volatility of price reaction to a given dividend initiation should be more for a "low information environment" firm relative to a "high information environment" firm since the former contains more unanticipated information and hence a higher uncertainty is associated with them. Following Mitra and Owers (1995) and Asquith and Mullins (1983) a "naive" expectations model is used which assumes that the initial dividend is unanticipated. The hypotheses tested are:

H_1 : There is a negative association between the firm's information environment and the Mean Standardized Abnormal Returns (MSAR) for a given initial dividend announcement.

H_2 : There is a negative association between the firm's information environment and volatility/increase in volatility in the "event period."

Sample Selection

A dividend initiation is defined as the (i) payment of cash dividend for the first time in the history of the firm, or (ii) payment of dividend for the first time after it was discontinued by a dividend paying firm due to losses or other reasons. Strictly speaking, dividend payment in (ii) above is not initial dividend. However, it is expected to trigger the price reaction similar to that of an initial dividend, therefore, it is also defined as the dividend initiation. Firms that initiated dividend between January, 2004 and December, 2010 were identified from the Prowess database of the CMIE and from the press releases/ advertisements by firms in the *Economic Times*/*Financial Express*. In addition, the firm should fulfil the following criterion for inclusion in the sample:

1. Daily closing prices of the firm must be available in prowess database for 90 days prior to the announcement date.
2. The firm should have no other price-sensitive announcement during the event window, that is, from 15 days before to 15 days after the date of dividend initiation announcement. This criterion ensures that any other information does not contaminate the conclusions of the study.

The Information Environment Proxy Measures

Since the information environment of the firm is not directly observable, proxies to represent it must be used. Mitra and Owers (1995) identified following four firm-specific characteristics as proxy variables for the information environment.

a) Size, as measured by Market Capitalization of the firm.

b) Number of Institutions holding the equity in the firm.

c) Percentage of Institutional Equity holding.

d) Number of Analysts following the firm.

They found these proxy variables quite useful in the examination of association between security price reaction and dividend initiation announcements in the context of the firm's information environment.

Several studies have reported a positive association between the amount of information generation and the capitalized value of the firm, which is defined as the market value of the equity share of the firm times the number of equity shares outstanding. In the context of examination of price reaction to dividend initiation announcements, market value of equity share of the firm is taken as its closing price at the end of the month preceding the month of the dividend initiation announcement (Mitra and Owers, 1995).

Bajaj and Vijh (1995) observed that average excess return to dividend announcements was negatively related to firm's size and its stock price. According to Arbel and Strebel (1982), and Arbel, Carvel, and Strebel (1983) small firms are neglected firms that do not get adequate attention from investment analysts, therefore, these are subject to less investment research and analysis. This essentially means that small firms are "low information environment" and that size is a good proxy for information environment. Atiase (1980), Eddy and Seifert (1988), Bhushan (1989) and Haw and Kim (1991) also reported that firm's size may be proxying for the firm's information environment. Of the four variables used, Mitra and Owers (1995) found market capitalization as the strongest proxy for the

information environment of the firm followed by the percentage of institutional equity holding. The number of analyst following and the number of institutions holding the equity in the firm had relatively less explanatory power. Thus in this article, two information environment proxy variables, namely, market capitalization and percentage of institutional equity holding are used, because of non-availability of data regarding number of analysts following and number of institutions holding the equity. Moreover, their exclusion is not expected to have significant effect on the findings since these were found to have relatively less explanatory power (Mitra and Owers, 1995).

Statistical Tests

Following Mitra and Owers (1995) and Eddy and Seifert (1988), initially two portfolios of the dividend initiating firms were created, each corresponding to one of the two information environment proxies. Firms within each portfolio were arranged in ascending order of the magnitude of the relevant proxy variable. Thereafter, each of these two portfolios was grouped into low, medium and high information environment levels for each proxy. Finally, for each proxy, the medium and high level portfolios were regrouped leaving two portfolios each, for both information environment proxy variables, that is, one portfolio comprising the "low" and the other portfolio comprising the "medium/high" level firms. While combining medium and high level portfolios based on each proxy, it is assumed that information environment level of the firm does not change significantly when it moves from medium to high level of that proxy. For example, after reaching a certain size, its future increments would not result in generation of significant additional information.

Analysis of Returns

Abnormal Return (AR) around dividend initiation announcement is defined as the difference between the realized return and the normal return, which is calculated by using the market model. Thus,

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt})$$

where, AR_{it} is the Abnormal rate of return on firm i for day t, R_{it} is the rate of return on firm i for day t, R_{mt} is the rate of return on the BSE Sensex for day t and α_i and β_i are the regression coefficients of the market model, estimated by regressing firm's rate of return against the rate of return on the BSE Sensex over an estimation period of t = –90 to t = –31 relative to each dividend initiation announcement.

Abnormal Returns (AR) and Mean Standardized Abnormal Returns (MSAR) were calculated over the event period, that is, from t = –15 to t = +15 days with respect to the dividend initiation announcement. t-values relative to the MSAR were computed as per procedure described in Brown and Warner (1985). Mean standardized abnormal returns over various intervals of the event period were examined by using the standardized mean cumulative abnormal return (SCAR) test statistic, described in detail in the Appendix to Dodd and Warner (1983).

Analysis of Volatility

Volatility (σ_i^2) is defined as:

$$\sigma_i^2 = \Sigma (R_t - \mu_R)^2 / N$$

where:

Summation in the above equation is carried from t =1 to t = N days.

R_t = Individual Day Return on the firm's stock over the period of N days, that is, from t = 1 to t = N.

μ_R = Average of individual daily returns on the firm's stock over the period of N days, that is, from t = 1 to t = N.

Volatility for each firm was computed over the estimation period and the event period, that is, over days t = –90 to t = –31 and t = –15 to t = +15, respectively. Event period was selected from days t = –15 to t = +15, since leakage of information in the Indian capital market has been observed (for example, see Chaturvedi 1999, 2001). The estimation and event period average volatilities were computed for each portfolio as the summation of volatilities of all firms in that portfolio dividend by the number of firms.

Following Kalay and Lowenstein (1985), the differences between estimation period and event period volatilities were examined by calculating the ratio(σ^2_{evt} / σ^2_{est}), where σ^2_{evt} and σ^2_{est} are the respective event period and estimation period volatilities of each portfolio.

The average volatilities of "low" and "medium/high" portfolios were calculated for each information environment proxy variable. For each information environment proxy variable, significance of differences in individual firm volatility ratios of low portfolios versus "medium/high" portfolios was tested using the Mann-Whitney U test.

Analysis of Information Environment Proxy Measures

The explanatory power of the proxy variables used in the analysis may overlap. Such overlapping was also observed

by Mitra and Owers (1995). However, construction of portfolios described at the beginning of this section assumes each proxy variable to be a discrete measure. The tests described above may not detect which of the proxy variable was relatively more powerful. Therefore, the following cross sectional multi-variate regression model was estimated for each announcement in the period from t = –6 to t = +5.

$$SCAR_i = \beta_0 + \beta_1 \ln(MKTCAP_i) + \beta_2 \ln(PIEH_i) + \beta_3 \ln(DIVY_i) + \varepsilon_i$$

where:

$SCAR_i$ = Standardized Cumulative Abnormal Returns for dividend announcement in the period from t = –6 to t = +5 days.

$\ln(MKTCAP_i)$ = Natural log of the Market Capitalization of the firm i.

$\ln(PIEH_i)$ = Natural log of Percentage of Institutional Equity holding in the firm i.

$\ln(DIVY_i)$ = Natural log of Dividend Initiation yield for the firm i.

ε_i = Random error term for firm i.

Empirical Results

Information Environment Proxy Data Description

Table 1 provides descriptive statistics of the information environment proxy variables for the entire sample of firms. Market capitalization of the sample firms ranges from a minimum of Rs. 90.4 crores to a maximum of Rs. 587.7 crores with a mean value of Rs. 269.9 crores and standard deviation of Rs. 212.5 crores. Thus, there are small as well as large firms in the sample which is useful in analyzing price reaction by taking size as information environment proxy. The percentage of institutional equity holding ranges from a minimum of 2% to a maximum of 75%. This wide dispersion of institutional holding in the sample firms justifies portfolio formation on the basis of institutional holding.

Table 1: Descriptive Statistics for two Information Environment proxy variables, namely Market Capitalization (MKT.CAP) and Percentage of Institutional Equity Holding (PIEH) for the Dividend Initiating Firms during the study period 2004–10.

	Sample Size	Mean	Std. Dev.	Minimum	Maximum
MKT.CAP (Rs. Crores)	152	269.9	21.5	90.4	587.7
PIEH	152	14%	27 %	2 %	75%

Abnormal Returns for the Entire Sample

Dividend initiation announcement is a price-sensitive information. Therefore, it is expected to trigger price reaction around the announcement period. An examination of abnormal returns around the dividend initiation announcements will validate the data and will provide support to "information content of dividend initiation." The daily average abnormal returns (AR), the cumulative average abnormal returns (CAR), the t-statistic and the Z-statistic for the entire sample, for the specified pre- and post announcement periods are reported in Table 2.

Table 2: Daily Average Abnormal Returns (AR) and Cumulative Average Abnormal Returns (CAR) in the 15 days pre- and post-announcement periods by 152 dividend initiating firms and corresponding t and Z statistics over the period 2004–10.

Panel A: Daily Abnormal Returns			
DAY	AR(%)	CAR(%)	t–statistics
–15	0.84	0.84	2.81**
–14	0.37	1.21	1.05
–13	–0.25	0.96	–0.42
–12	0.57	1.53	1.45
–11	0.48	2.01	1.32
–10	0.53	2.54	1.37
–9	–0.39	2.15	–0.94
–8	–0.15	2.00	–0.37
–7	0.49	2.49	1.48
–6	1.25	3.74	3.43*
–5	0.92	4.66	2.97**
–4	0.87	5.53	2.41**
–3	0.58	6.11	1.98
–2	2.87	8.98	6.92*
–1	1.04	10.02	2.44**
0	0.51	10.53	1.47

Panel B: Interval Abnormal Returns		
Interval	CAR (%)	Z-Statistics
0 to +2	4.37	6.72*
0 to +5	5.05	6.39*
0 to +10	6.33	6.82*
0 to +15	8.21	7.24*

Notes:
* Significant at the .01 level of confidence.
** Significant at the .05 level of confidence.

Occurrence of abnormal returns up to 15 days before the announcement suggests that the market anticipated it or more likely, there was insider trading activity. The –15 day AR is .84% which is significant at the 0.05 level. Moreover, the –6 day AR is 1.25% which is significant at 0.01 level. Out of 15 days for which ARs are calculated in the pre-announcement period, as much as 12 are positive with 2 ARs significant at 0.01 level and 4 are significant at 0.05 level. Not much adjustment takes place on the day 0, when board meets to make the announcement (AR on this day is only 0.51 which is not significant even at 0.05 level). The impact of dividend initiation announcement on prices continued up to 15 days after the announcement. The results presented in Table 2 are consistent with overseas studies. The dividend initiation announcements trigger significant price reactions.

Portfolio Formation: Isolating Dividend Yield Differences

The objective of the present article is to examine the association between magnitude and volatility of securities' returns, with the firm's information environment, for the dividend initiating firms. Two information environment proxies namely the size and the percentage of institutional equity holding are used for this analysis. As discussed in the earlier section, two portfolios comprising "low" and "medium/high" firms for each proxy were formed. Several studies have reported a positive association between the magnitude of abnormal returns around the dividend initiation announcements and the size of the dividend announced. A true test of influence of information environment of the firm on price reactions can be carried out by controlling the separate confounding impact of the magnitude of the dividend yield. That is, both the portfolios must have approximately the same dividend yield.

Details regarding "low" and "medium/high" portfolios within each proxy, along with their dividend yields are provided in Table 3. The table reveals that 90 firms are included in the "low" and 62 firms are in the "medium/high" market Capitalization portfolio. It is to be noted that firms with market capitalization of less than Rs. 225 crores are defined as "low" information environment firms and those with market capitalization of Rs. 225 crores and above as "medium/high" information environment firms. The average dividend yield on "low" portfolio is 0.065 which is not comparable to the average dividend yield on "medium/high" portfolio. Six firms were scrutinized for having very large dividend yield relative to the remaining firms in the "low" portfolio. Their removal from the portfolio resulted in the average dividend yield of 0.051 for the "low" portfolio of the remaining firms. The average dividend yield (.051) of the revised "low" portfolio is more comparable to the average yield (.048) of the "medium/high" portfolio. Thus, the final sample of the size proxy consists of 146 firms, of which 84 are categorized in the "low" portfolio and 62 are categorized in the "medium/high" portfolio.

Table 3: Pre- and post-Dividend Yield Controlled Portfolios on "Low" and "Medium/High" Information Environment Proxies, namely Market Capitalization and Percentage of Institutional Equity Holding

Information Environment Proxy	Port folio Code	Number of Firms	Average Dividend Yield
Panel A: Market Capitalization			
Less than 225 crores	LB[a]	90	.065
Less than 225 crores	LA[a]	84	.051
225 crores & above	MH	62	.048
Panel B: Percentage of Institutional Equity Holding			
2% to 15%	LB[a]	96	.059
2% to 15%	LA[a]	87	.053
Above 15%	MH	56	.052

Notes:
LB = "Low" portfolio before controlling for dividend yield.
LA = "Low" portfolio after controlling for dividend yield.
MH = "Medium/High" portfolio.

In the same manner, pre- and post-dividend yield controlled portfolios for "low" and "medium/high" percentage of institutional equity holding proxy were formed and details regarding their groupings are reported in the Table 3.

Abnormal Returns and Firm's Information Environment

Table 4 provides details regarding cumulative daily average abnormal returns and Z-statistics for different intervals in the event window for "low" and "medium/high" information environment proxy portfolios. The pre-announcement period was split into two intervals viz from t = –15 to t = –7 days and from t = –6 to t = 0 days, since in Table 2, –6th was the first day on which relatively very large abnormal returns were observed. Findings regarding abnormal returns in relation to each information environment proxy are described below.

Market Capitalization

Cumulative abnormal returns (CARs) for different intervals, in the event window in context of size as the information

Table 4: Cumulative Daily Average Abnormal Return (CAR) and Z-statistics for the Pre- and Post-Dividend Announcement Periods for Low and Medium/High Information Environment Proxy.

Panel A : Market Capitalization				
Period (in days)	Low Portfolio (N^a = 84)		Medium/High Portfolio (N^a = 62)	
	CAR (%)	Z- Statistics	CAR (%)	Z- Statistics
–15 to –7	5.84	3.94**	3.01	1.95
–6 to 0	11.51	6.57*	6.70	5.31**
+1 to +5	8.03	5.46*	3.05	2.78**
+1 to +15	13.97	8.79*	7.27	5.89*
Panel B : Percentage of Institutional Equity Holding				
Period (in days)	Low Portfolio (N^a = 87)		Medium/High Portfolio (N^a = 56)	
	CAR (%)	Z-Statistics	CAR (%)	Z- Statistics
–15 to –7	4.97	3.47**	2.07	1.25
–6 to 0	12.79	6.29*	5.31	2.84**
+1 to +5	6.86	4.97**	2.43	1.67
+1 to +15	11.49	8.05*	3.99	2.35**

Notes:
a N is the number of dividend initiations in each portfolio.
* Significant at .01 level
** Significant at .05 level

environment proxy, as reported in Panel A of Table 4 reveal that they are much larger in magnitude, in all the intervals, for "low" portfolio relative to the "medium/high" portfolio. From the table, all the CARs of the "low" portfolio are significant (t = –15 to t = –7 days CARs are significant at 0.05 level while remaining three are significant at 0.01 level), while for the medium/high portfolio, t = –15 to t = –7 days CARs are not significant and only t = +1 to t = +15 days CARs are significant at 0.01 level. Overall the results suggest that dividend initiation announcements convey much more information for the firms in the "low" portfolio than for the firms in the "medium/high" portfolio, both in the pre- as well as in the post-announcement period in the context of the Market Capitalization as the proxy.

Percentage of Institutional Equity Holding

From Panel B of Table 4, the CARs of the "low" portfolio are significant for all the intervals. While CARs for days from t = –15 to t = –7 and for days from t = +1 to t = +5 are significant at 0.05 level, those (CARs) for days from t = –6 to t = 0 and for days from t = +1 to t = +15 are significant at 0.01 level. The "medium/high" portfolio CARs are significant only for days from t = –6 to t = 0 and for days from t = +1 to t = +15, and that too at 0.05 level. The other two intervals CARs are not significant. A high level of significance and more pronounced CARs of the "low" portfolio relative to the "medium/high" portfolio implies that the dividend initiation, convey more information for the firms with less percentage of institutional equity holding than for the firms having larger institutional stake.

Analysis of Volatility

Event period and estimation period volatilities for the "low" and "medium/high" portfolios in the context of market capitalization and percentage of institutional equity holding are compared in Table 5. As stated earlier, in this study, the estimation period is from 90 days to 31 days before

Table 5: Ratios of Event Period (t = –15 to t = +15 days) and Estimation Period (t = –90 to t = –31 days) Average Daily return Variances (σ^2_{evt} / σ^2_{est}) for "low" and "medium/high" Portfolios in the context of Market Capitalization and Percentage of Institutional Equity Holding, Information Environment Proxies

Information Environment	N^a	σ^2_{evt} / σ^2_{est}
Panel A : Market Capitalization		
Low	84	2.137
Medium/High	62	1.305
Panel B: Percentage of Institutional Equity Holding		
Low	87	1.973
Medium/High	56	1.286

N^a is the number of firms for which the variance ratio has been calculated

the dividend initiation announcement and event period is from 15 days before to 15 days after the announcement. The ratios of "event period" and "estimation period" average daily return variances for the "low" portfolios are 2.137 and 1.973 respectively for the market capitalization and percentage of institutional equity holding proxies. For the medium/high portfolios, these are relatively lesser in magnitude at 1.305 and 1.286 respectively for the market capitalization and percentage of institutional equity holding proxies. Comparatively larger ratios of average daily return variances for "low" portfolio relative to "medium/high" portfolio suggest that more uncertainty around the dividend initiation announcements is associated with the former than with the latter.

These results are consistent with other studies which reported increase in volatility around dividend announcements (for example, Kalay and Lowenstein [1985]) and greater volatility for "low" information environment firms relative to "medium/high" information environment firms, around the dividend initiation announcements.

Analysis of Information Environment Proxy Measures

The analysis of returns around dividend initiation announcements in the context of information environment of the firm has been conducted in the preceding section by constructing "low" and "medium/high" portfolios for each information environment proxy. Grouping of firms in portfolios assumes no overlapping in the explanatory power of the proxy variables. However, these variables tend to have considerable commonness. For example, firms with small capitalization are associated with low percentage of institutional equity holding. Another drawback of this approach was pointed out by Lobo and Mahmoud (1989). According to them, this approach assumes homogeneity of firms within a portfolio in terms of availability of public information. However, there are possible cross-sectional differences in the availability of prior information within each portfolio.

The above drawbacks are attempted to be reduced by using uni-variate and multi-variate regression analysis with SCAR, in the period from t = –6 to t = +5 days, as the explained variable and Market Capitalization, Percentage of Institutional Equity holding and Dividend Yield as the explanatory variables. The results of the regression are reported in Table 6. Panels A and B in the Table provide results of the uni-variate and multi-variate regressions respectively. The regression coefficients of the proxy variables, shown in Panel A, are all statistically significant. The coefficient of market capitalization and percentage of institutional equity holding are negative and that of dividend yield is positive. A negative coefficient indicates inverse relation while a positive coefficient implies direct relationship. The signs of coefficients are consistent with the results presented in earlier section. Among the three independent variables, the statistical significance is highest for the market capitalization and lowest for the dividend yield. The adjusted R^2 is maximum for the market capitalization, which suggests that it explains more variation in SCAR than percentage of institutional equity holding or dividend yield.

Table 6:

Panel A

Results of Uni-variate Regressions for t = –6 to t = +5 days with Standardized Mean Cumulative Abnormal Return (SCAR) as the explained variable and Market Capitalization, Percentage of Institutional Equity Holding and Dividend Yield as the explanatory variables, respectively.

Case I	$SCAR_i$ =	β_0 +	$\beta_1 \ln(MKTCAP_i) + \varepsilon_i$
	Estimates:	10.0547	-1.6835
	t-statistics:	5.9704[a]	-4.8435 [a]
F- Statistics : 15.320			
Adjusted R^2 = 0.0782			
Case II	$SCAR_i$ =	β_0 +	$\beta_1 \ln(PIEH_i) + \varepsilon_i$
	Estimates:	0.5937	–0.7734
	t-statistics:	0.6359	–3.4267 [a]
F- Statistics : 7.405			
Adjusted R^2 = 0.0605			
Case III	$SCAR_i$ =	β_0 +	$\beta_1 \ln(DIVY_i) + \varepsilon_i$
	Estimates:	7.0943	1.4731
	t-statistics:	2.9305[b]	2.9437[a]
F- Statistics : 5.936			
Adjusted R^2 = 0.0561			

Panel B

Results of Multi-variate Regression for t = –6 to t = +5 days with Standardized Mean Cumulative Abnormal Return as the explained variable and Market capitalization , Percentage of Institutional Equity Holding and Dividend Yield as the explanatory variables.

$SCAR_i$ =	β_0 +	$\beta_1 \ln (MKTCAP_i)$	+ $\beta_2 \ln$ + $(PIEH_i)$	$\beta_3 \ln (DIVY_i) + \varepsilon_i$
Estimates :	9.5607	–1.5801	–0.5638	0.7834
t-Statistics:	(4.3120[a])	(–3.9043[a])	(1.9930)	(1.5720)
F-Statistics : 5.3904				

Results of the multivariable regression presented in Panel B of Table 6 give insights into the relative explanatory power of the three variables, i.e., market capitalization, percentage of institutional equity holding and dividend yield. The signs of the coefficients are negative for market capitalization and percentage of institutional equity holding and positive for dividend yield proxy. These results are consistent with the result of uni-variate regression reported in Panel A of Table 6. However, t-statistic is significant at 0.05 level only for the coefficient of market capitalization, all other coefficients are not significant at this level.

The results presented in Table 6 are qualitatively similar to the findings of overseas studies which examined dividend initiation announcements (Mitra and Owers (1995))

and dividend changes (Bajaj and Vijh (1990); Eddy and Seifert (1988); Haw and Kim (1991)), Market capitalization has been found to be the most powerful explanatory information environment proxy variable followed by the percentage of institutional equity holding.

Summary and Conclusions

A number of studies have supported the information content of dividend hypothesis. Changes in dividend is considered as a credible source of information as opposed to the announcements made by firms, about their future prospects which are viewed by the market with a great deal of skepticism, mainly because firms routinely make exaggerated claims. The price changes and increase in volatility surrounding the dividend announcements should be a function of the information content of dividend announced. Information content of the dividend announcement is the unanticipated information it contains. Only a change in dividend conveys new/unanticipated information.

A given change in dividend may convey different levels of unanticipated information, depending upon the information environment of the firm. For example, a large sized, heavily traded and widely monitored firm will have more publicly available information than a small sized, not so closely followed firm. Announcement of a given change in dividend may convey less information for the former than the latter. Since, the information environment of a firm is not directly observable, in the international studies, proxies such as size, as measured by market capitalization of the firm, number of institutions holding the equity in the firm, percentage of institutional equity holdings and number of analysts following the firm are used to represent it.

This article has empirically examined the association between *magnitude and volatility* of security price reaction and the firm's information environment in the context of dividend initiation announcements. Relative magnitude and volatility of price reaction to the dividend initiation announcement of various information environment (high or low) firms is indicative of the information content of these announcements. Two proxy measures of the information environment of a firm size, as measured by market capitalization of the firm and percentage of institutional equity holdings are used in the study.

The results of the study suggest occurrence of abnormal returns up to 15 days before the dividend initiation announcements which continue up to 15 days after the announcement for the entire sample. That is, price adjustment to dividend initiation announcements is not instantaneous, which violates the efficient market hypothesis. The influence of information environment of firms on price reaction is tested by constructing portfolios by controlling the separate confounding impact of the magnitude of dividend yield for both the information environment proxy measures. Overall, the results suggest that dividend initiation announcements convey much more information for the portfolio with small sized firms than the medium/high portfolio in the context of market capitalization, both in the pre- as well as the post announcement period. Also, the study found that the dividend initiation conveys more information for the firms with less institutional holding than for the firms having larger institutional stake. Further, the ratios of event period and estimation period average daily return variances are much larger for the "low" portfolios than for the "medium/high" portfolios for both the market capitalization and percentage of institutional equity holding proxies. This confirms that more uncertainty is associated with the former than with the latter.

The results obtained by using uni-variate and multi-variate regression analysis with Standardized cumulative abnormal returns as the explained variable and Market capitalization, Percentage of institutional equity holding and Dividend yield as the explanatory variables are consistent with the results reported in the preceding paragraph. However, it suggests that among the three independent variables, the statistical significance is highest for the market capitalization and lowest for the dividend yield.

In conclusion, the results of this study are qualitatively similar to the findings of overseas studies which examined association between stock returns and dividend initiation announcement. Size as measured by market capitalization is more powerful information environment proxy variable than the percentage of institutional equity holding. Another interesting finding of this study is that stock prices do not adjust instantaneously to the dividend initiation as hypothesized by the efficient market hypothesis.

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For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled.

—Richard Feynman

Feature

Understanding Product Flow and Information Flow Dimensions in Cashew Nut Supply Chains

DEEPAK BHAGAT AND U.R. DHAR

This article tries to examine the product flow and information flow dimension of cashew nut supply chains in Garo hills of Meghalaya. It is based on the responses of 270 small holder cashew nut growers distributed across three districts in Garo hills of Meghalaya. It shows that these holders are in a disadvantageous position due to the producers' share in consumer rupee found to be between 51–59%. The present study deduces that the information flow (either forward or backward) is unsatisfactory in these cashew supply chains. These factors affect the traditional supply chains in hilly areas to a great extent.

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The high value agricultural commodity industry can be immensely expanded provided the producers are assured of better supply chains, marketing facilities, and reasonable prices for their produce. Marketing is an integral part of supply chains. And accurate and timely information flow makes marketing more efficient. The efficiency of marketing of high value agricultural commodities in India has been of significant concern in the recent years. Poor efficiency in the marketing channels and inadequate marketing infrastructure are believed to be the cause of not only high and fluctuating consumer prices, but also too little of the consumer's rupee reaching the farmer (Ashturker and Deole, 1995; Kaul, 1997). Indian farmers typically depend heavily on middlemen. The producers and the consumers often get a poor deal and middlemen control the market, but do not add much value. There is also massive wastage, deterioration in quality as well as frequent mismatch between demand and supply both spatially and over time (Singh et al., 1985; Subbanarasiah, 1991). This calls for a better and improved marketing system with timely and accurate information flow in supply chain. In the light of these concerns, this article tries to examine marketing and information flow dimensions in supply chains of cashew nut in Garo hills of Meghalaya. To make it more meaningful and important to the society in the present situation and years to come, considering there will be an increase in the small holders and decrease in size of holding (ICAR Vision 2030), this study tries to analyze cashew supply chain from small holder's perspective.

Originally introduced in India during 16th century by Portuguese, cashew has emerged as an important crop among commercial agricultural commodities. However, marketing of raw cashew nut in India has not yet been organized and systematized (except Goa to some extent)

with itinerant merchants and processing unit's agents playing major role. There is evidence of opening of collection centers by wholesalers and processing factories also. Sometimes big processors contact the producers directly and enjoy good bargaining power by providing credit facilities to the producers. All these considerably bring down the producers share in consumer rupee (http://dccd.gov.in/tech.htm). In Garo hills of Meghalaya, though most of cashew production of the region is done, their processing is done in Phulbari and Mancachar. Raw cashew nuts are also going out of Meghalaya through Garobandha outside the region for processing in Orissa and also in Andhra Pradesh. The cashew nut processing units in the region has processing capacity ranging from 700 kg to 1 tonne a day. It is a labor-intensive industry with every factory having 200–300 laborers, mostly women. Three main qualities of cashew nuts are available in the market of Garo hills. The quality is adjudged according to a code. These are:

Best quality (Code = 6 J) @ Rs. 440 per kg.

Medium quality (Code = 4 J) @ Rs. 420 per kg.

Low quality (Code = 1 J) @ Rs. 360 per kg.

Methodology

Data Collection

This study is based on a sample of 270 small holder cashew nut growers distributed across three districts in Garo hills of Meghalaya (East Garo hills, West Garo hills, and South Garo hills). The sample of the small holder growers were drawn through multistage random sampling technique. The survey was conducted in the period of July 2010 to March 2011 and it involved personal face-to-face interviews with pretested questionnaires. A brief description about profile of respondents is given in Table1.

Table 1: Profile of Small Holders Cashew Nut Growers

Sl. No.	Particulars	Cashew nut farmers
1	No. of farmers	270
2	Average area (acre)	3.65
3	Average marketed surplus per farmer (kg)	1869.56
4	Average age of respondents (years)	47.2
5	Average family size (numbers)	4.89
6	Average education level (years of formal education)	7.78

When a unit of analysis is extended from dyadic relationship to a supply chain, sampling becomes a problem (Masuku, 2003). Since, a food chain network consists of a number of chains having multiple interconnected firms/player, it is almost impossible to deal with all the chains of the network and all the constituent firms/players. Hence, for the purpose of information flow, in this study, the cashew nut supply chain having maximum quantity of disposal was selected. Since, focus of the study was information flow by the small holders and to the small holders, in this study, information flow dynamics in cashew supply chain were explored from the small holders and their immediate partner's perspective.

Two major supply chains of cashew nut have been found in the study area (Table 2). Most of the cashew nut (about 72.17%) was found to be transacted through supply chain 1 (that is, through producer–preharvest contractor–whole seller–processor–distant market wholesaler–retailer–consumer). Thus, this supply chain was selected for the purpose of the study of information flow.

Table 2: Cashew Nut Supply Chains in Garo Hills of Meghalaya

Chain No.	Supply chains	Percentage of quantity transacted
1	Producer–Preharvest contractor–Whole seller–Processor–Distant market wholesaler–Retailer–Consumer	72.17
2	Producer–Commission agent–Whole seller–Processor–Distant market wholesaler–Retailer–Consumer	27.83

It has been found that out of 270 small holders growing cashew nut (total study sample for cashew nut growers), in channel 1 (as selected for information flow study) 193 small holder cashew nut growers used to market through 23 preharvest contractors of cashew nut in the study area (Table 3). Thus, information flow study in cashew nut supply chain was based on responses from 193 small holder cashew nut growers about 23 preharvest contractors dealing in cashew nut marketing in Garo hills of Meghalaya (India).

Data Analysis

Analysis of Product Flow Dimension of Cashew Nut Supply Chain

To understand the economics of marketing of cashew nut first the marketing channels/supply chains are identified

Table 3: Disposal Pattern of Cashew Nut by Small Holder Cashew Nut Growers

Sl. No.	Agencies	No. of of agencies	No. of farmers selling product to these agencies	Average marketed surplus per farmer for respective agencies (Kg)	Total quantity sold (Kg)	Percent
1	Preharvest contractor	23	193	1887.65	364316.80	72.17
2	Commission agent	21	77	1824.23	140465.46	27.83
	Total		270	1855.94	504782.26	100.00

(Table 2). The economics of marketing of cashew nut was estimated by using the concepts and formulae given by Acharya and Agarwal (2004).

1. **Marketing Cost:** The marketing cost in cashew nut supply chain was estimated as:

$$C = C_F + C_{m1} + C_{m2} + C_{m3} + \ldots + C_{mn}$$

where,

C = Total cost of marketing of cashew nut (Rs/qt)

C_F = Cost paid by the producer- farmer (Rs/qt)

C_{mi} = Cost incurred by the ith middleman in the process of marketing of cashew nut (Rs/qt)

2. **Marketing Margin:** The marketing margin at any stages of marketing of cashew nut was calculated as follows:

$$MM_i = SP_i - (PP_i + MC_i)$$

where,

C = Total cost of marketing of cashew nut (Rs/qt)

MM_i = Marketing margin of the ith middleman

SP_i = Selling price of ith middleman

PP_i = Purchase price of the ith middleman

MC_i = Marketing cost incurred by ith middleman

After calculating the marketing margins at different stages, finally the total marketing margin in cashew supply chain was estimated.

3. **Producer's share in consumer's rupee:** The producers share in consumer's rupee was worked by the following method:

$$P_S = (P_F/Pr) * 100$$

where,

P_S = Producer's share in consumer's rupee (%)

P_F = Producer's price (Rs/qt)

Pr = Price paid by the consumers (Rs/qt)

4. **Marketing efficiency:** The marketing efficiency of different channels of marketing cashew nut was estimated as:

$$ME = FP / (MC + MM)$$

where,

ME= Index of marketing efficiency

FP = Price received by the farmer (Rs/qt)

MC = Total marketing costs (Rs/qt)

MM = Net marketing margins (Rs/qt)

Analysis of Information Flow Dimension of Cashew Nut Supply Chain

Accurate information makes supply chain more effective. Proper information flow in an agriculture supply chain will lead to proper product movement, good relationship development and this will ultimately lead to a sustainable supply chain. In order to analyze the information flow in cashew nut supply chain and understand the gap if any, following research questions have been formulated.

(a) Whether the forward information flow that deals with availability of cashew nut, its quality assurance, size, variety, etc., is satisfactory.

(b) Whether the backward information flow that deals with quality feed back, price, quantity, timing, modern technology, etc., are satisfactory.

To achieve the requisite objectives, following null hypotheses were formulated.

Ho = There is no true difference in the importance attached by farmers and their chain partner to different information requirements in the supply chain.

Ho = There is no significant difference between information need and actual information received by the supply chain players from their partners.

It has been assumed that availability of no difference in information need and actual information received by the supply chain players from their partners will lead to satisfaction and if there is any significant difference, then this will lead to dissatisfaction.

The first hypothesis was tested with *Z* test.

$$z = \frac{(X_1 - X_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

where,

$\bar{X}_1$ = mean of the sample taken from population 1 (producer farmers)

μ_1 = mean of population 1 (producer farmers)

σ_1^2 = variance of population 1 (producer farmers)

n_1 = size of the sample taken from population 1 (producer farmers)

$\bar{X}_2$ = mean of the sample taken from population 2 (preharvest contractors)

μ_2 = mean of population 2 (preharvest contractors)

σ_2^2 = variance of population 2 (preharvest contractors)

n_2 = size of the sample taken from population 2 (preharvest contractors)

The second hypothesis was tested with paired (or related samples) *t* test. Here, there is lack of independence between the two groups (farmers and preharvest contractors) because the sample individuals are matched as repeated measurements are obtained from the same set of individuals. Thus, paired *t* test was found appropriate.

Paired (or related samples) t test (based on Levine et al., 2006)

$$t = \frac{\bar{D} - \mu_D}{S_{\bar{D}}} = \frac{\bar{D} - \mu_D}{S_{\bar{D}} / \sqrt{n}}$$

where,

$\bar{D}_1$ = the (sample) mean of the difference scores

μ_D = the mean difference in the population

S_D = the sample SD of the difference scores (with division by n–1)

n = number of matched pairs; the number of individuals = 2n

$S_{\bar{D}}$ = the SE of the mean difference

df = n–1

On the basis of extensive literature survey, pilot survey and discussion with various experts following information parameters were identified to achieve the specific objectives of this study. Table 4 presents the various information parameters studied to understand the information flow in various supply chains along with their definition/justification.

Table 4: Information Parameters in Agribusiness Supply Chain

Sl. No.	Information parameter	Definition/Justification
Forward information flow		Forward information flow means information flow from farmer to preharvest contractor.
1	Product availability	Product availability means sharing of information weather in coming new season the farmer will have product available for sale to the concerned supply chain partner.
2	Produce quality (with grading and standardization)	Produce quality means information given by the farmer to supply chain partner regarding the quality of the product (viz. free from pest and disease, size, grade, etc.)
3	Production quantity	Production quantity means information given by farmer regarding how much marketable surplus he will be having preferably in advance.

Table Contd. ...

Table to be continued...

Sl. No.	Information parameter	Definition/Justification
4	Production process or methodology adoptedin	Production process mean information given by farmer regarding the process adopted production of the commodity under study, whether any fertilizers are used, what type of planting material used, etc.
5	Production Timing	Production timing deals with the information regarding possible harvesting time when the commodity under study can be available in the market for sale.
6	Pricing	Pricing means information regarding price to be quoted by the farmer when the product comes to the market.
Backward information flow		Backward information flow means information flow from pre- harvest contractor to farmer.
1	Product planning	Product planning mean information given by the supply chain partner to the farmer regarding production planning to tap the market when prices are going to be high, for example, off-season cultivation or taking the advantage of time utility, etc.
2	Time and technology of harvesting	Time and technology of harvesting means information given by supply chain partner regarding the ideal time of harvesting a particular commodity and how best it can be harvest technologically so that there is minimum wastage of commodity because of improper harvesting technique.
3	Storage technology	Good storage technique increases the self life of agricultural commodities. Here storage technology information means information given by supply chain partner regarding different storage techniques (both modern and low cost) to the farmer so that they can increase the self life of agricultural commodities.
4	Pest control measures	Pest damages the crop. Here pest control measures means information given by supply chain partner to farmers regarding different techniques so that the farmer can save their crop from different types of pest and disease attack.
5	Grading and standardization	The quality of farm produce brought to the market by the farmers varies considerably over space and time. It is therefore, essential to grade the farm produce so that the farmer gets the price he deserves. Here grading and standardization means information given by the supply chain partner regarding various grading acts, grades, etc.
6	Service	Service means making farmers aware about various services given by them (supply chain partners) to the farmers.
7	New production process or methodology	New production process or methodology means information given by the supply chain partner regarding transfer of technology from research stations to farmers' field, that is, making farmer aware about new production techniques developed in the research stations.
8	Logistic information	Logistic information means providing information to the farmers regarding cheapest transport available so that farmer can bring the produce to the market place.
9	Government policy information and credit source)	Most of the time farmers could not take advantage of government policies only because they are not aware of them. Government policy information in this study means information given by supply chain partners to farmers regarding various policies, for example, credit, subsidy, etc.
10	Pricing as well as current prices	Information about price helps in getting proper return from the commodity, increases bargaining power as well as develops trust in the relationships. It is very important that supply chain partner share frequent fluctuations in prices of commodities to the producers.
11	Sales timing	Sales timing refers to information provided by supply chain partners regarding time when demand is high and when they are further going to sell the commodity and when consumers are going to by it.
12	Customer order, preferences, quality feedback (Consumer behavior)	Understanding of consumer behavior is very important to properly market one's commodity and survive survive in the market. Thus it becomes very important that supply chain partners provide proper information to the farmers regarding the consumer behavior.

Table 5: **Marketing Cost of Cashew Nut incurred in Different Channels**

Sl. No		Name of functionary/Item of cost	Cha	
			1	
			Rs/q	Rs/q
1		Producer		
	a	Gross price received by the producer	4141.00 (50.88)	4785.00 (58.80)
	b	Cost incurred by the producer		
	i	Grading		30.81 (0.38)
	ii	Transportation		
	iii	Loading/Unloading		
	iv	Storage		
	v	Wastage		51.19 (0.63)
	vi	Market fee		
	vii	Miscellaneous		
	b	Net price received by the producer	4141.00 (50.88)	4703.01 (57.79)
2		Commission agent		
	a	Cost incurred by the Commission agent		
	i	Commission of agent @ Rs.1/kg or Rs 100.00 per quintal including transportation		100.00 (1.23)
	b	Commission agent sale price/ wholesaler purchase price		4803.01 (59.02)
3		Preharvest contractor		
	a	Cost incurred by the Preharvest contractor		
	i	Grading		
	ii	Transportation	70.69 (0.87)	
	iii	Loading/Unloading	10.11 (0.12)	
	iv	Storage		
	v	Wastage		
	vi	Market fee	30.28 (0.37)	
	vii	Miscellaneous	40.42 (0.50)	
	viii	Margin of PHC	393.50 (4.84)	
	b	Preharvest contractors sale price/wholesaler purchase price	4686.00 (57.58)	
4		Wholesaler		
	a	Cost incurred by the wholesaler		
	i	Grading		
	ii	Transportation	115.14 (1.41)	115.14 (1.41)

Table Contd. ...

Table to be continued...

Sl. No		Name of functionary/Item of cost	Channels	
			1	2
			Rs/q	Rs/q
	iii	Loading/Unloading	5.05 (0.06)	5.05 (0.06)
	iv	Storage		
	v	Wastage		
	vi	Market fee	80.77 (0.99)	80.77 (0.99)
	vii	Miscellaneous	10.13 (0.12)	10.13 (0.12)
	viii	Margin of wholesaler	456.51 (5.61)	457.90 (5.63)
	b	Wholesaler sales price/processor purchase price	5353.60 (65.78)	5472.00 (67.24)
5		Processor		
	a	Cost incurred by the processor		
	i	Processing cost (Including storage)	883.75 (10.86)	883.75 (10.86)
	ii	Miscellaneous	25.25 (0.31)	25.25 (0.31)
	iii	Margin of processor	1006.20 (12.36)	887.80 (10.91)
	b	Processor sales price/retailer purchase price (22 kg processed of 1 quintal raw cashew)	7268.80 (89.31)	7268.80 (89.31)
6		Distant market wholesaler		
	a	Cost incurred by distant market wholesaler		
	i	Transportation	36.78 (0.45)	36.78 (0.45)
	ii	Storage	48.63 (0.60)	48.63 (0.60)
	iii	Miscellaneous	11.18 (0.14)	11.18 (0.14)
	iv	Margin of distant market wholesaler	461.71 (5.67)	461.71 (5.67)
	b	Distant market wholesaler sales price	7827.10 (96.17)	7827.10 (96.17)
7		Retailer		
	a	Cost incurred by the retailer		
	i	Transportation	20.23 (0.25)	20.23 (0.25)
	ii	Miscellaneous	20.17 (0.25)	20.17 (0.25)
	iii	Retailer margin	270.90 (3.33)	270.90 (3.33)
	b	Retailer's sale price(SP)/Consumer's purchase price	8138.40 (100.00)	8138.40 (100.00)

Table 6: Marketing Cost, Margins and Price Spread of Cashew Nut

Sl. No		Particulars	Channels	
			1	2
1		Producer		
	a	Gross price	4141.00	4785.00
	b	Cost incurred		81.99
	c	Net price	4141.00	4703.01
2	a	Commission agents purchase price		4703.01
	b	Commission of commission agent (considered as margin)		100.00
	c	Commission agents sales price		4803.01
	d	Margin as percent of PP		2.13
3		Preharvest contractor		
	a	Gross purchase price	4141.00	
	b	Cost incurred	151.50	
	c	Sales price	4686.00	
	d	Net margin	393.50	
	e	Profit as percent of pp	9.50	
4		Wholesaler		
	a	Gross purchase price	4686.00	4803.01
	b	Cost incurred	211.09	211.09
	c	Sales price	5353.60	5472.00
	d	Net margin	456.51	457.90
	e	Profit as percent of pp	9.74	9.53
5		Processor		
	a	Gross purchase price	5353.60	5472.00
	b	Cost incurred	909.00	909.09
	c	Sales price of processed nuts	7268.80	7268.80
		(22 kg processed of 1 quintal raw cashew)		
	d	Net margin of Raw nuts	1006.20	887.71
	e	Profit as percent of pp	18.79	16.22
6		Distant market wholesaler		
	a	Gross price	7268.80	7268.80
	b	Cost incurred	96.59	96.59
	c	Sales price	7827.10	7827.10
	d	Net margin	461.71	461.71
	e	Profit as percent of pp	6.35	6.35
7		Retailers		
	a	Gross price	7827.10	7827.10
	b	Cost incurred	40.40	40.40
	c	Sales price	8138.40	8138.40
	d	Net margin	270.90	270.90
	e	Profit as percent of pp	3.46	3.46
8		Total marketing cost	1408.58	1339.16
9		Total marketing margin of intermediaries	2588.82	2178.22
10		Price spread	3997.40	3517.38
11		Producers share in consumer rupee (%)	50.88	58.80
12		Marketing efficiency	1.04	1.36

Results and Discussion

Understanding Product Flow Dimension in Cashew Nut Supply Chain

As discussed above, in the present study two major marketing channels of cashew nut involving smallholders were identified in Garo hills of Meghalaya. In the following section the marketing cost, margin, price spread and marketing efficiency of these cashew nut supply chain are discussed.

Channel 1

This particular supply chain of cashew nut was confined to those small cashew growers who are having relatively large orchards (though less than 2 ha). This is the most commonly used supply chain in case of cashew nut. This supply chain consists of producer, preharvest contractor, wholesaler, processor, distant market wholesaler and retailer. The producers sold raw cashew nut at the rate of Rs. 4141.00 to preharvest contractor who then sold the cashew nut to wholesalers at the rate of Rs 4686.00 per quintal. The wholesalers then sold it to processors at the rate of Rs 5353.60 per quintal. About 22 kg of dry cashew nut is derived from the raw cashew nut after processing. Thus processors sold processed cashew nut to distant wholesalers at the rate of Rs 7268.80 per 22 kg of processed cashew nut. Retailers purchased the processed cashew nut from the distant wholesalers at the rate of Rs 7827.10 per 22 kg of processed cashew nut and sold it to consumers at the rate of Rs 8138.40. The total price spread in this supply chain was found as Rs. 3997.40 with net total margin of intermediaries as Rs. 2588.82. It was found in the study that processors earned highest net margin of Rs. 1006.20 among all the intermediaries involved in this supply chain. The total cost of marketing in this channel was found as Rs 1408.58. As expected, processors incurred maximum cost (Rs. 909.00) with more expenditure on processing and storage (Rs 883.75). A significant amount of cost was incurred as transportation cost also (Rs 242.84). The producers share in consumer rupee was found as 50.88% which is lowest in comparison to Channel 2. The marketing efficiency of this chain was estimated as 1.04.

Channel 2

This supply chain consists of producer, commission agent, wholesaler, processor, distant market wholesaler and retailer. The producers sold raw cashew nut at the rate of Rs. 4785.00 to commission agent who after taking commission of Rs 100.00 transferred the raw cashew to wholesalers at the rate of Rs 4803.00 per quintal. In fact the commission agents purchased the raw nuts from the producers on behalf of the wholesalers. The wholesalers then sold it to processors at the rate of Rs 5472.00 per quintal. About 22 kg of dry cashew nut is derived from the raw cashew nut after processing. Thus processors sold processed cashew nut to distant wholesalers at the rate of Rs 7268.80 per 22 kg of processed cashew nut. Retailers purchased the processed cashew nut from the distant wholesalers at the rate of Rs 7827.10 per 22 kg of processed cashew nut and sold it to consumers at the rate of Rs 8138.40. It was found that the total price spread in this supply chain was Rs 3517.38 with net margin of intermediaries as Rs 2178.22. As expected, just like previous supply chain, the processors earned a major share of total net margin and incurred higher cost of marketing and processing (Rs 909.09). The total cost of marketing in this supply chain was estimated as Rs. 1339.16. Just like previous supply chain of cashew nut a significant amount of cost incurred was because of transportation. The producers are benefitted in this supply chain with producers share in consumer rupee as 58.80%. This was because of the absence of preharvest contractor from this supply chain of cashew nut. The marketing efficiency of this supply chain was estimated as 1.36 which is more than previous supply chain.

Understanding Information Flow Dimension in Cashew Nut Supply Chain

Table 7 presents the mean rating of various information factors by the farmers and preharvest contractor in cashew nut supply chain. The table also shows what the different information parameters are where there is significant difference in importance attached by them. The table is divided into two sections- forward information flow and backward information flow. In case of forward information flow i.e. transfers of information from farmer to preharvest contractor there is no significant difference in importance attached by farmers and preharvest contractors. That means both the players have attached similar importance the information factors under study.

However, as far as backward information flow is concerned, the table shows that there are some information parameters where the farmers and preharvest contractors have attached significantly different importance. These information parameters are pest control measures, service, new production process or methodology, logistic information, government policy information (credit source), pricing as well as current prices and sales timing. In all,

Table 7: Mean Rating of importance of Information (where 1= "not at all important" and 5= "very important" in Cashew Nut Supply Chain

Sl. No	Factor	Farmer (193)	Preharvest contractor(23)	z-stat
Forward information flow				
1	Product availability	4.526	4.636	-0.7672
2	Produce quality (with grading and standardization)	3.792	3.955	-1.2949
3	Production quantity	4.359	4.545	-1.1700
4	Production process or methodology adopted	2.156	2.591	-2.9453
5	Production Timing	3.599	3.955	-2.5121
6	Pricing	4.125	4.500	-2.5306
Backward information flow				
1	Product planning	2.422	2.455	-0.1885
2	Time and technology of harvesting	3.781	4.364	-4.0703
3	Storage technology	3.891	4.273	-3.1224
4	Pest control measures	3.740	3.364	2.8001**
5	Grading and standardization	3.990	4.318	-1.8855
6	Service	4.557	4.091	3.5038**
7	New production process or methodology	4.438	3.864	6.9275**
8	Logistic information	4.568	4.136	3.5289**
9	Government policy information (credit source)	4.563	4.182	3.9310**
10	Pricing as well as current prices	4.547	3.818	5.0862**
11	Sales timing	4.349	3.909	3.2048**
12	Customer order, preferences, quality feedback (Consumer behavior)	4.495	4.318	1.2569

** Significant at the 0.05 level (two-tailed).
z Critical two-tail: 1.959964

these cases, the average importance's attached by farmers are higher than the preharvest contractors thus it can be concluded that preharvest contractors have failed to understand the importance of the information what farmers believes vital for them.

Table 8 presents the extent to which farmers and preharvest contractor meet each other information needs in cashew nut supply chain (information required is considered same as importance attached). In short, this table tries to find out if there is any significant gap in information required and supplied by the both the parties. Just as above table, this table has also been divided into two sections- forward information flow and backward information flow. The table shows that in case of forward information flow, there is significant difference in all the information parameters regarding information felt important and information received by the preharvest contractors in cashew nut supply chain. All the information parameters are product availability, produce quality (with grading and standardization), production quantity, production process or methodology adopted, production timing and pricing. There is significant difference in information felt important and information received by the preharvest contractors in above cases. In case of backward information flow in all the information parameters there is significant difference in information felt important and information received by the famers in cashew nut supply chain.

This poor information flow has prevented the development of potential win-win model for both the parties in cashew nut supply chain. This model could have been turned into the most glamorized modern contract farming system and most importantly would have been very effective in traditional supply chains in remote hilly areas where corporate houses hesitate to enter because of many

Table 8: Extent to which Farmer and Pre- harvest Contractor meet each other needs in Cashew Nut Supply Chain

Sl. no	Factor	Farmer wants	Preharvest contractor wants	Farmer gets	Preharvest contractor gets	t- stat	
						Farmer	Preharvest contractor
Forward information flow							
1	Product availability	x	4.636	x	1.955	x	13.3041**
2	Produce quality (with grading and standardization)	x	3.955	x	2.136	x	9.4032**
3	Production quantity	x	4.545	x	2.591	x	7.1058**
4	Production process or methodology adopted	x	2.591	x	1.364	x	6.2413**
5	Production Timing	x	3.955	x	2.364	x	9.3701**
6	Pricing	x	4.500	x	1.636	x	11.9364**
Backward information flow							
1	Product planning	2.422	x	1.130	x	27.0422**	x
2	Time and technology of harvesting	3.781	x	1.969	x	55.4020**	x
3	Storage technology	3.891	x	2.786	x	18.8434**	x
4	Pest control measures	3.740	x	2.964	x	12.4990**	x
5	Grading and standardization	3.990	x	4.234	x	-3.7593**	x
6	Service	4.557	x	2.875	x	32.2772**	x
7	New production process or methodology	4.438	x	2.557	x	28.8052**	x
8	Logistic information	4.568	x	1.854	x	53.2455**	x
9	Government policy information (credit source)	4.563	x	2.854	x	33.8024**	x
10	Pricing as well as current prices	4.547	x	3.896	x	13.6339**	x
11	Sales timing	4.349	x	4.214	x	2.2878**	x
12	Customer order, preferences, quality feedback (Consumer behavior)	4.495	x	2.370	x	33.5635**	x

** Significant at the 0.05 level (2-tailed).
t Critical two-tail: 2.079614 (at 21 d.f) and 1.972462 (at 191 d.f)

reasons. Now this poor information flow has hampered this. A lack of trust has been developed among both the supply chain players and this potentially win-win model is looked upon as a channel where the preharvest contractor takes the maximum benefit and exploits the farmers. This situation is not very encouraging and can be considered as one of the prime factors affecting the traditional supply chains in hilly areas and hampering them to take advantage of supply chain management which is reaped by other industries across the world.

An attempt was also made to find out the possible reasons for this gap. For the gap in forward information flow, following points came out.

a) Farmers were themselves not very sure about the quantity of output they are going to receive. Moreover, they also do not realize the importance of information sharing to preharvest contractor and how this is going to make difference to their (farmers) profit.

b) Most of farmers follow very traditional way of cultivation, so they do feel that preharvest contractor may not have any interest in this type of information.

c) Once the deal is made between pre- harvest contractor and the farmers, farmer does not show much interest in the crop, so he does not have much to share to pre- harvest contractors.

Similarly on investigating what prevented preharvest contractor in supplying the proper and adequate information to the farmers, following points came out.

a) Most of the preharvest contractor themselves lack scientific information regarding different aspects of production and protection as well as harvesting. If at all they know it is non scientific. So technically they are not sound enough to share proper information with farmers.

b) Some of the preharvest contractor feels that in some cases even if told, farmers do not adopt. There is lack of motivation among the farmers to take farming as a business profession.

c) Some time since preharvest contractor does not have much expectation from the farmer, they themselves do the necessary activities required for the crop instead of sharing the technology to them.

Managerial and Policy Implications

From the study it can be said that time has come to make a shift from traditional supply chain system in agriculture to modern improved supply chain management. This calls for development of an information system having components such as market search, prices and transaction conditions. At the same time adequate and accurate transportation system should be developed. Members of local communities should be encouraged to provide transport services. All these will lead to a new improved agriculture supply chains, more scientific in nature and creating win- win situation for all the stakeholders of the chain.

Conclusion

In an attempt to understand the product flow dimension and information flow dimension of cashew supply chain, the study finds that in Garo hills of Meghalaya, the small holders are in disadvantageous position with producers share in consumer rupee found to be between 51–59%. Channel 2 found to be most efficient among the two channels found in the study area. Presence of pre-harvest contractors in Channel 1 is one of the reasons for this. timely and accurate information flow, which is very important to make supply chain more efficient. However the study finds that the information flow (both forward and backward) is not satisfactory. This situation is not very encouraging and can be considered as one of the prime factors affecting the traditional supply chains in hilly areas and hampering them to take advantage of supply chain management which is reaped by other industries across the world.

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We still do not know one thousandth of one percent of what nature has revealed to us.

—Albert Einstein

Feature

Impact of Global Financial Crisis on Developing Economies

BADAR ALAM IQBAL, MUNIR HASSAN AND FARHA NAAZ GHAURI

Global financial crisis is becoming a chronic problem for every one. It is a double-edged sword cutting both ways. It has created far-reaching effects, consequences, and implications for both parts of the world—developed world and developing world. This crisis is creating many social problems, such as unemployment, poverty, and hunger. It is also indirectly affecting the availability of funds for most chronic global problems due to climate change and global warming. Hence, this article deals with some vital issues relating to global financial crisis in general and effects of it on developing economies.

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The developing world is paying a huge economic price for the present global financial crisis, which was originated at the center of global financial system. Accordingly, growth in the developing world is slowing dramatically and so many economies are finding it very difficult to sustain their respective economies. Some emerging economies may face the danger of falling into a deflationary trap.

Can the Financial Crisis become a Calamity for Poor Nations?

The global financial crisis could become "a human and development calamity" for many poor economies, especially, African economies. Accordingly, The World Bank is urging upon the donor countries to accelerate the delivery of money that they have agreed upon and also think about further pledge of money to overcome the crisis (*Times Business*, 2009).

Developing nations, its main constituency, face "especially serious consequences, impact and implications" with the crisis driving more than 50 million people into extreme poverty, particularly women and children (Youssef Boutros-Ghali).

The World Bank is responding through its existing healthy balance sheet to increase lending up to US$100 billion over three years and launch initiatives in social protection, public works, and agriculture. No one can say how long it would last or when recovery would start.

Effects of Crisis on Developing Nations

The most unfortunate thing is that the developing economies are not the real culprits or responsible for the escalating financial crisis, which was originated and started from the United States, especially in the finance sector and thereafter affected the rest of the globe, badly affecting

multiple sectors and areas. This crisis struck the developing world through channels of trade and finance. Although, economists have mainly concentrated on how the global financial crisis has affected the developed world, the picture and situation has been reverse. The effects of global financial crisis are more intensive and extensive in the developing world. As a result, ramifications are of more serious nature (*Times Business*, 2009).

The serious effects of global financial crisis are in terms of plummeting exports, quick and sharp decrease in Gross National Product (GNP), considerable decline in industrial production, substantial decrease in gross capital flows, increasing unemployment, poverty, social development, external debt crisis, trade balance, balance of payments, and foreign exchange reserve depletion (*South Bulletin,* 2009).

Transformation through Finance Route

The economists world over believe that there are four routes of global financial crisis in developing nations:

1. Many economies have global financial crisis due to heavy investment in toxic or depreciated assets. The main countries that have lost substantial funds are Singapore as well as the Middle East oil producing nations who have made huge investment in big, US, Swiss, and UK banks. China has also made investment in toxic assets. Similarly, people from Singapore and Hong Kong have made investment in Lehmann Brothers, which has gone into bankruptcy. Likewise, people from Latin America have invested in US-based Stanford Bank, which is now mired in fraud charges.

2. There has been substantial decline in funds that are flowing into developing economies. Accordingly, net capital flows to emerging economies have gone down from US$929 billion in 2007 to US$466 billion in 2008 and thereafter went down further to a level of US$165 billion in 2009 (Institute of International Finance, IIF). Out of the total capital flows to developing countries, portfolio investment that went up considerably in developing economies has gone out, especially from the sale of shares in the stock markets. In case of bond markets, business transactions in emerging markets recorded a decline of US$45 billion, that is, from US$50 billion during the second quarter of 2008 to only US$5 billion during the last quarter of 2008.

3. There has been a constant and alarming reverse flow in bank credit, the lifeline of economic development, which always based on capital formation. According to IIF, the banks worldwide would take out more in debt repayment in emerging markets which they provide or extend in new loans.

4. The existing flow of FDI has been slowed down. According to UNCTAD, the FDI flows have gone down by 21% and in absolute terms they stood at US$1.4 trillion during 2008. The degree of effect of FDI is more in case of developed economies. While on the other hand, FDI flows to developing economies have shown a rise of 4% in 2008. But this rise is much lower than the rise recorded during 2007, that is, 21%.

Transformation through Trade Route

This is the second most vital route through which the global financial crisis entered into developing world. There are many ways that have affected developing economies.

1. One of the major instruments through which the developing economies provide some degree of sustainability to their economies like exports. The exports of many developing countries have gone down alarmingly because of the sharp decline in demand for good in the two biggest regions, namely, the Europe and the USA. According to the latest available data, export value has declined by 46% in Japan, 44% in Taiwan, 40% in Philippines, 38% in case of Singapore, 34% in case of South Korea, and 28% in case of Malaysia. The effect is of worst nature in case of China where hundred of units have closed down and the nearly 20 million people went out of jobs (UNCTAD, 2008).

2. Trade in services also constitutes a significant share in overall trade. This segment of trade also felt the heat due to global financial crisis. One of the major segments of trade in services is tourism which has recorded a decline of 1% in tourist arrivals in the second half of 2008. Similarly, in the Caribbean region that heavily depends upon tourism, the decline is estimated at one-third of the present session (Times Nations, 2009). The other two vital segments are outsourcing and remittances. On both the counts, developing economies have been much affected, resulting into sharp decline in foreign exchange (6% in 2009) on the one hand and on the other hand, increasing unemployment.

3. In developing economies banks play a vital and strategic role in the promotion of foreign trade and therefore, always extend finance to traders so that they can export more. This component is facing a worsening as the banks are tightening the supply of credit for day-to-day export and import business. According to World Trade Organization (WTO), there is considerable shortfall in trade financing in developing economies and the shortage of funds amounted to US$25 billion. This gap has to be filled in by all means.

4. The decline in capital inflows or outflows along with decrease in exports of goods has resulted into deterioration in the balance of payments as well as in forex reserves of so many developing economies. Accordingly, such countries have taken drastic action by devaluating their respective currencies and as a result, these nations are finding it difficult to make debt servicing. For example, Pakistan and Sri Lanka have approached the IMF for funds to avoid debt defaults.

Role of Multilateral Agencies

Multilateral agencies may contribute positively and constructively in the process of easing out global meltdown. The IMF and IBRD are playing an increasing role in this direction.

IMF

Not any longer, member countries that joined the Fund during the period 1945–1971, had agreed to maintain fixed exchange rate between their respective currencies and the US dollar. But this Bretton Woods system fell apart when a high rate of inflation in the United States and the rising trade deficit prompted the people of the United States to allow dollar to float. Since then, IMF members have been free to choose any kind or form of exchanger arrangement they wish or like (except pegging their currency to gold); allowing the currency to float freely; pegging it to another currency or a basket of currencies; adopting a currency of another country or participating in a currency block. These trends have added fuel to fire and global financial crisis has erupted (*Times Nations*, 2009).

Recently, the IMF has pinpointed that global economy is yet to weather the worst of a recession that claimed a record number of European jobs. The 16-countries Euro Zone lost a record 1.22 million jobs in the first quarter. The number of employed fell from 1.2% year-on-year, the deepest annual drop measurements started in 1965. In the words of Howard, "markedly weakening labor markets are a major threat to recovery prospects in the Euro Zone." Statistics are slightly better in case of the United States.

World Bank

In managing the global financial crisis, the role of the World Bank is more positive and constructive. The World Bank is also determining what additional measure is required to counteract the worst global financial crisis in the decades. The World Bank has also invited G-7 and then G-20 nation groups for deliberations. These groups were of the opinion that more needs to be done as the global financial crisis is of unfolding nature. These groups have also asked all donors to speed up delivery of commitments to increase aid and for all to go beyond their existing commitments. According to these groups, the world economy is stabilizing, but it would take until mid-2010 for the world to emerge from the worst has also invited G-7 and then G-20 nations group. These groups were of the opinion that more needs to be done as the global financial crisis is of unfold nature. These groups have also asked all donors to speed up delivery of commitments to increase aid and for all to go beyond their existing commitments. According to these groups, the world economy is stabilizing, but it would take until mid-2010 for the world to emerge from the worst recession in decades. Stimulus packages, bank recapitalization and other needed measures taken by the governments and central banks to deal with crisis are beginning to show results. "Financial markets are trending up and other economic indicators are improving, but there are still downside risks" (South Bulletin, 2009).

Role of Asia

Driven by India and China, the emerging Asian economies no longer witness slump, which would lead the global recovery (The UK Financial Services, 2009). The slump in activity in emerging Asia is over. The region returned to positive growth of the aggregate level in the first quarter of 2009 (Barklays Capital Investment Company, 2009–10).

The other major Asian economies wherein positive growth has been witnessed are Taiwan, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Thailand, and Hong Kong. Asian region is trying hard to assume a more assertive role in overcoming the global financial crisis. The implications of a stronger and wealthier Asia exercising a positive and purposeful role and contribution are of far reaching for the world economy. A

number of developing economies in the Asian continent are building up policy space through responsible policy management and are in a position to ease monetary and fiscal policies to provide countercyclical support.

Many developing countries have much less room to manoeuvre. These countries face difficult external situations wherein capital flows have reversed and hence require tightening policies to reduce risks of a capital account crisis (*Times Business*, 2009). Therefore, it would be more appropriate to make sure that large scale financial stimulus is available as required from official sources, to help developing economies deal with difficult external financial conditions.

BRIC Economies

BRIC countries are coming up as faster growing. Similarly, India is among the fastest growing BRIC nations and is ready to play positive and coordinating international efforts to over come the on going financial and economic slowdown. Brazil, Russia, India, and China well-known as BRIC nations and Shanghai Cooperation Organization have come together for a meeting in regard to coordinate efforts for facing the challenge of global financial and economic crisis. This group has come to a saying that we have the potential to lead global economic growth as economic recovery is closely linked to the success of BRIC countries (Times of India, 2009).

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> *We shall require a substantially new manner of thinking if mankind is to survive.*
>
> ***—Albert Einstein***

Feature

The Short Run and Long Run Employment Functions in the Industrial Sector- A Comparative Study of Two Regions of Andhra Pradesh

B. NARAYANA

This article seeks to analyze the nature of relationship among the employment, output, and wage rate of industrial sector in the two regions of Andhra Pradesh for the period 1990–91 to 2006–07 by estimating the short-run and long-run elasticities of employment with respect to output and wage rate. Main finding of this study, based on time-series data showed that the elasticity of employment with respect to output of the industrial sector in the two regions of Andhra Pradesh is positive but less than unity, showing the low labor absorption capacity of the industrial sector in the two regions which implying that the growth of employment was lagging behind the growth of output.

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It is well known that industrial sector has been playing a crucial role in the Indian Economy. So far Government of India has been given much more importance to industrialization since inception of Second Five Year Plan onward through industrial policy resolutions. As a result, uneven industrial development has been taken place across the states in India which again resulted in uneven development in the different regions of Andhra Pradesh. Therefore, there is a need to explore the empirical information on the nature of growth of employment, output and wage rate and labor absorption capacity in the industrial sector, which will be very useful to formulate a suitable policy and strategy for bringing the balanced development in the industrial sector of different regions of Andhra Pradesh.

Need for the Study

There are some following important influential studies relating to the employment elasticities in the industrial sector of India based on the labor demand function derived from the constant elasticity of substitution (CES) function under the profit maximization condition (that is, marginal product of labor equal to wage rate). Goldar's (1987) study found that the short-run and long-run elasticity of employment with respect to output, keeping the wage rate constant was 0.25 and 0.80, respectively, during the period 1960 to 1977. Seth and Seth (1991) analyzed labor absorption in the Indian manufacturing sector during the period 1960 to 1984. The estimates of short-run and long-run elasticity of employment were obtained by them were very similar to the estimates presented by Glodar. Ghosh's (1994) study reported that there was a sharp decline in the elasticity of employment in the organized manufacturing industry in 1980s. The study by Jayadevan

(1997) depicted that the elasticity of employment in the organized manufacturing industry declined from 0.52% in the first period to 0.14% in the second period. The results of the study carried out by Upender (1998) showed that the estimate of elasticity of employment was very low, that is, 0.31 during 1980–81 to 1993–94 and all these studies also represents that the magnitude of elasticity of employment with respect to wage rate, keeping the output constant, was not only negative but also less than one.

Thus, the review of estimates of above-mentioned earlier studies relating to the elasticity of employment showed that the numerical value of elasticity of employment with respect to output was very low. Moreover, these studies have been carried out on the labor absorption at the national level and no effort seems to have been taken to analyze the labor absorption in the industrial sector at regional level where industrial sector occupies key role in the process of economic development. Hence, it is worthwhile to generate empirical information on the extent of labor absorption in the industrial sector of two regions of Andhra Pradesh because no such effort has been made in the past and it will be very useful in understanding the extent of labor absorption and provide useful clear insights into labor absorption capacity in the industrial sector of two regions of Andhra Pradesh. Therefore, the present study is an attempt to test the validity of the above results for the period 1990–91 to 2006–07 (17 years) of the industrial sector in the two regions, that is, Coastal Andhra and Telangana region of Andhra Pradesh. Though the results of this study do not shed any light on the elasticities of employment with respect to output and wage rate of individual factories/firms within the industrial sector.

Objectives

In the light of above discussion, the following specific objectives have been set forth in the present study.

1. To find out whether there is any acceleration or not in the rate of growth of employment/output/ wage rate of industrial sector in the two regions of Andhra Pradesh for the period 1990–91 to 2006–07 (17 years).
2. To examine the labor absorption capacity of industrial sector in the two regions of Andhra Pradesh for the period 1990–91 to 2006–07.

Database

The required secondary time series data on employment, emoluments, and total output of industrial sector in the two regions of Andhra Pradesh was collected for the period 1990–91 to 2006–07 from the year-wise Annual Survey of Industries (ASI) published by Directorate of Economics and Statistics, Government of Andhra Pradesh, Hyderabad. Electricity sector was excluded from the two regions of Andhra Pradesh in the study, due to non-availability of district-wise/ region-wise electricity units.

Due to non-availability of data on selected variables of industrial sector in the two regions of Andhra Pradesh, this study could not be extended beyond the time period 2006–07.

Methodology

Keeping the above objectives in view, the following methodology has been adopted for effective analysis.

1. In this study, with a view to find out to the acceleration/deceleration/stable in the rate of growth of employment/output/wage rate of industrial sector in the two regions of Andhra Pradesh, the following log-quadratic form of equation has been fitted to the time series points for the period 1990–91 to 2006–07 (17 years). A problem posed by log-quadratic equation is multicollinearity because of the correlation between "t" and "t^2." This problem has been tackled by using the transformation $t_1 = t - (n + 1)/2$ ("n" is number of years in a time series data) since the correlation between "t" and "t_1" is zero.

$$\text{Log}Y_t = a + b_1 t + b_2 t^2$$

where,

$\text{Log}Y_t$ = employment/output/wage rate
t = time in years
t^2 = square of the independent variable (t)

"b_1" is the instantaneous growth rate per annum. If "b_2" is statistically significant with positive, then there will be an acceleration (an increase) in the rate of growth of employment/output/wage rate of industrial sector in the two regions of Andhra Pradesh during the period 1990–91to 2006–07. If "b_2" is significant with negative, then there will be deceleration (fall) in the rate of growth of employment/output/wage rate. If "b_2" is not significant then there can be a constant or stable (homogeneity) in the rate of growth of employment/output/wage rate.

If $b_2^* > 0$, then there will be an acceleration in the rate of growth of employment/output/wage rate of industrial sector in the two regions of Andhra Pradesh during 1990–91 to 2006–07.

If $b_2^* < 0$, then there will be deceleration in the rate of growth of employment/output/wage rate of industrial sector in the two regions of Andhra Pradesh during 1990–91 to 2006–07.

where, * shows the level of significance

2. To examine and analyze the extent of labor absorption in terms of short-run and long-run employment elasticities of the industrial sector in the two regions of Andhra Pradesh during the period under consideration, the following methodology by adopting the estimated procedure outlined by Upender (2004) has been used.

$$\text{Log EMP} = a + b \log OP + c \log WR + \text{error} \quad \ldots . (1)$$

where,

EMP = Employment

OP = Total output

WR = Wage rate

This equation has been derived from a constant elasticity of substitution (CES) production function under the condition of profit maximization.

$$EMP_t^* = a\, OP_t^b\, WR_t^c$$

This can be written as

$$\text{Log } EMP_t^* = a + b \log OP_t + c \log WR_t \quad \ldots .(2)$$

where,

EMP_t^* = Desired level of employment

OP_t = Total output

WR_t = Wage rate

Desired level/ long run level/equilibrium level/ optimum level of employment (EMP_t^*) is not directly observable. In order to estimate the above equation, the following partial adjustment mechanism has been considered.

$$EMP_t \text{ “} EMP_{t-1} = (EMP_t^*/EMP_{t-1})$$

This can be written as

$$\text{Log } EMP_t - \log EMP_{t-1} = \delta(\log EMP_t^* - \log EMP_{t-1}) \quad \ldots . (3)$$

where,

EMP_t^* = Desired level of employment which is not directly obtainable

$\text{Log } EMP_t - \log EMP_{t-1}$ = Actual change in the level of employment

$\text{Log } EMP_t^* - \log EMP_{t-1}$ = Desired change in the level of employment

δ = coefficient of speed of partial adjustment between the desired change in the level of employment and the actual change in the level of employment

If the value of coefficient of partial adjustment (ä) is close to one, then the difference or disequilibrium between the desired change and the actual change in the employment is quickly reduced. If the value of coefficient of partial adjustment (δ) becomes zero, then there will be no change between EMP_t and EMP_{t-1} ($EMP_t - EMP_{t-1} = 0$). If the value of "δ" < 1, then actual change in the level of employment will be lower than the desired change in the level of employment ($EMP_t / EMP_{t-1} < EMP_t^* / EMP_{t-1}$). If the value of "$\delta$" is equal to one, then actual change in the level of employment will be equal to desired change in the level of employment ($EMP_t / EMP_{t-1} = EMP_t^* / EMP_{t-1}$). The above equation (3) indicates that a constant percentage of the discrepancy between the actual and desired level of employment can be eliminated within a single year.

The following short-run employment function (SREF) has been derived by substituting equation (2) into equation (3) and rearranging. This function represents that demand for labor in current year (t) depends on output, wage rate in current year(t) and demand for labor in previous year(t–1).

$$\text{Log } EMP_t = \delta \log a + \delta b \log OP_t + ä c \log WR_t + (1-\delta)\log EMP_{t-1} \quad \text{or}$$

$$\text{Log } EMP_t = a^* + b^* \log OP_t + c^* \log WR_t + d^* \log EMP_{t-1} \quad \ldots . (4)$$

where,

$a^* = \delta \log a$

$b^* = \delta b$

$c^* = \delta c$

$d^* = 1 - \delta$

$\delta = 1 - d^*$

(i) b^* and c^*'s are the short-run elasticities (SRE), that is, $b^* > 0$, the short-run elasticity of employment with respect to output. $c^* < 0$, the short-run elasticity of employment with respect to wage rate. It is to note that the time period is not enough to adjust employment completely to the changes in output and wage rate.

(ii) The long run elasticities (LRE) of employment with respect to output and wage rate can be indirectly estimated by dividing short run employment function(SREF) by the coefficient of partial adjustment (ä) and dropping the log EMP_{t-1}.

$$LREF = \frac{SREF}{\delta} \quad \text{or}$$

$$LREF = \text{Log } EMP_t / \delta = a^*/\delta + b^* \log OP_t / \delta + c^* \log WR_t / \delta \quad \text{—} \quad \ldots\ldots(5)$$

where,

LREF= Long run employment function

It is to note that generally, the value of coefficient of adjustment (δ) will be less than one. Therefore, the long-run elasticities of employment will be higher as compared to the short-run elasticities.

Results and Discussion

The nature of growth of employment, output and wage rate of industrial sector in the two regions of Andhra Pradesh was presented in tables 1 and 2.

It can be observed from Table 1 that the growth of employment was positive but stable while growth of output was negative and stable. The growth of wage rate was decelerating in the industrial sector of coastal Andhra region of Andhra Pradesh. As far as Telangana region is concerned, there was deceleration in the growth of employment, output and wage rate of industrial sector (Table 2). On the whole, there was no accelerated growth in employment, output and wage rate of industrial sector in the two regions of Andhra Pradesh.

The empirical results of the short-run and long-run employment functions based on time series data reported in tables 3 and 4, respectively. It can be observed from Table 3 that all the estimated regression coefficients were significant except the coefficient of demand for labor in the previous year (t–1) and expected signs. The short-run elasticity of employment with respect to output was 0.31 indicating that an increase in output by one% would lead to raise the employment by 0.31% per annum in the industrial sector of coastal Andhra region of Andhra Pradesh. It was in line with Okun's law according to which the elasticity of employment with respect to output will be less than one (1974). The numerical value of coefficient of wage rate, that is, elasticity of employment with respect

Table 1: Nature of growth of Employment, Output and Wage rate of Industrial Sector of Coastal Andhra Region of Andhra Pradesh during 1990–91 to 2006–07

S.No.	Fitted Equation	R^2	R^{-2}	Nature of Growth
1	EMP= 5.372 + 0.004t + 0.00007t^{2**} (2.365) (0.172)	0.29	0.18	Stable
2	OP = 3.713 + 0.064t – 0.001t^{2**} (32.450) (– 0.974)	0.99	0.98	Stable
3	WR = - 2.822 + 0.043t – 0.002t^{2*} (38.810) (– 6.574)	0.99	0.99	Deceleration

Table 2: Nature of growth of Employment , Output and Wage rate of Industrial Sector of Telangana Region of Andhra Pradesh during 1990–91 to 2006–07

S.No.	Fitted Equation	R^2	R^{-2}	Nature of Growth
1	EMP= 5.723 + 0.006t – 0.0001t^{2*} (4.302) (– 2.947)	0.66	0.61	Deceleration
2	OP = 3.863 + 0.052t – 0.002t^{2*} (24.997) (– 3.855)	0.98	0.98	Deceleration
3	WR = – 2.902 + 0.038t – 0.001t^{2*} (40.482) (– 5.342)	0.99	0.99	Deceleration

Note:
1. Figures in parentheses are 't'- values of respective coefficients
2. * Statistically significant at 1% level

Table 3: The Short Run Employment Function of Industrial Sector in the Two Regions of Andhra Pradesh during 1990–91 to 2006–07

S.No.	Fitted Equation	R^2	R^{-2}
Coastal Andhra	LogEMP = 2.518 + 0.309logOP* – 0.408 logWR** + 0.105 log EMP_{t-1} (3.067) (– 2.772) (0.494)	0.49	0.36
Telangana	LogEMP = 2.354 + 0.436logOP – 0.443 logWR + 0.067 log EMP_{t-1} (1.554) (– 1.139) (0.245)	0.54	0.43

Note:
1. Figures in parentheses are 't'-values of respective coefficients
2. * Statistically significant at 1% level and ** statistically significant at 5% level

to wage rate was negative and less than unity representing that an increase in wage rate by one% lead to reduce the employment by 0.41% per annum. If this growth rate of output is being continued in this region, the cumulative effect of short run elasticity of employment with respect to output over a long period would increase the employment by 0.34%, keeping the wage rate constant (Table 4). The cumulative effect of short run and long run elasticity of employment with respect to wage rate leads to reduce

Table 4: The Long Run Employment Function of the Industrial Sector in the Two Regions of Andhra Pradesh during 1990–91 to 2006–07

Region	Fitted Equation
Coastal Andhra	LogEMP = 2.813+ 0.345logOP– 0.456 logWR
Telangana	LogEMP = 2.523 + 0.467logOP – 0.475 logWR

Note:
1. Figures in parentheses are t- values
2. * Statistically significant at 5% level and ** statistically not significant
3. Significance test for long run elasticities are not provided because they are indirectly computed.

the employment by 0.46% per annum, keeping the output constant. It can also be observed that the long run elasticites were substantially greater than short run elasticities. The value of coefficient of employment lagged by one year was not significant evincing that there was a lag without significant in the adjustment of actual labor absorption to its desired level of labor absorption. The value of coefficient of partial adjustment was 0.895 showing that about 89% of discrepancy between the desired level of employment and actual level of employment would be eliminated in a year in the industrial sector of coastal Andhra region of Andhra Pradesh.

As far as Telangana region of Andhra Pradesh is concerned, all the estimated coefficients were statistically not significant but with expected signs. The short-run elasticity of employment with respect to output was 0.44 showing that 1% increase in the level of output leads to increase the employment by 0.44% per annum in the industrial sector and it was also in line with Okun's law. The value of elasticity of employment with respect to wage rate was found to be negative and less than unity (–0.44) showing that 1% increase in the wage rate will reduce the employment by 0.44% per annum. If this growth rate of output is being continued, the cumulative effect of short run elasticity of employment with respect to output over a long period will increase the employment by 0.47% per annum (Table 4), provided the wage rate remains constant. The cumulative effect of short-run elasticity of employment with respect to wage rate will reduce the employment by 0.47% per annum, provided the output remains constant. The estimated value of coefficient of partial adjustment was 0.933 implying that about 93% of discrepancy between the desired level of employment and actual level of employment will be eliminated in a year in the industrial sector of this region.

On the whole, the short run output elasticity of employment was less than unity but it was slightly higher in the industrial sector of Telangana region as compared to Coastal Andhra region evincing that the labor absorption capacity of the industrial sector of these two regions of Andhra Pradesh was very low. The estimated value of employment elasticity with respect to wage rate was negative in the industrial sector of two regions showing a significant gap between cost of labor and labor–capital ratio. If this situation is allowed to continued, labor absorption capacity would deteriorate further in the industrial sector of these regions.

Conclusion

The major findings of this petite study based on time series data may, now be noted. There was no accelerated growth

in employment, output and wage rate of industrial sector of both regions of Andhra Pradesh. The short run output elasticity of employment was less than unity in the industrial sector of both Coastal Andhra and Telangana region representing that the labor absorption capacity of the industrial sector of these two regions of Andhra Pradesh was very low and the estimated value of elasticity of employment with respect to wage rate was negative in the industrial sector of two regions showing a significant gap between cost of labor and labor–capital ratio. If this situation is allowed to continue further, unemployment problem would further be intensified. Therefore, there is a need to restructure the industrial sector towards more labor absorption as these two regions of Andhra Pradesh have large amount of labor.

Notes

1. Total output comprises total ex-factory value of products and by products manufactured as well as other receipts from non industrial services rendered to others, work done for others on material supplied by them, value of electricity produced and sold and sale value of goods sold in the same conditions purchased.
2. Employees include all workers and persons receiving wages and holding supervisory or managerial positions engaged in administrative office, store keeping section and welfare section, sales department as also those engaged in the purchase of raw materials etc or the purchase of fixed assets for the factory and watch and ward staff.
3. Total emoluments is defined as the sum of wages and salaries, employers contribution as provident fund, other funds and work men and staff welfare expenses.
4. Wage rate was estimated by deflating the total emoluments by the employees (that is, ratio of total emoluments to the employees).

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There is a sufficiency in the world for man's need but not for man's greed.

—Mahatma Gandhi

Feature

Ricardian Equivalence Hypothesis: Evidence from Pakistan

MUHAMMAD AFZAL

This article provides empirical evidence on the soundness and relevance of the Ricardian Equivalence hypothesis for Pakistan over the period 1960–2009. Time series properties have been examined in order to take care of the criticism made against the previous studies on REH notably model-specification, simultaneity bias and stationarity of data. Real income, real consumption, real government expenditure, and real government revenue, though nonstationary, are not cointegrated. There is unidirectional causality from real income to real consumption, real government expenditure and real government revenue and from real government expenditure to real government revenue. We used impulse response functions to ascertain the impact of shocks of one variable upon others. The impact of real government expenditure and real government revenue on consumption is most notable and substantial that provides some support in favor of the REH. This happens in the short run. Stabilization policies are adopted that aim at averting those shocks that harm the economy substantially in the short run

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The Ricardian equivalence hypothesis is an economic theory that suggests it does not matter whether a government finances its spending with debt or a tax increase, the effect on total level of demand in an economy being the same. Governments can raise money either through taxes or by issuing bonds. Since bonds are loans, they must eventually be repaid presumably by raising taxes in the future. The choice is therefore, "tax now or tax later."

David Ricardo was the first to propose this possibility, though he was unconvinced of it (McCulloch, 1888). Antonio De Viti De Marco elaborated on Ricardian equivalence starting in the 1890s (Feldstein, 1985). Robert J. Barro (1974, 1979) took the question up independently in the 1970s, in an attempt to give the proposition a firm theoretical foundation. The proposition remains controversial (Elmendorf and Mankiw, (1998).

According to the Ricardian equivalence hypothesis (REH), tax cuts do not affect desired consumption and hence desired saving given no change in current or planned government purchases because people know that they will pay higher taxes in future as the government has to pay its debt in the form of higher taxes that implies lower future disposable income. However, the Ricardian equivalence proposition may not apply if consumers fail to take into consideration the expected future tax increases in their planning. In such situation a tax cut will increase consumption and reduce saving (Abel and Bernanki, 2001). The REH simply states that consumers are indifferent or equivalent regarding the way government finances expenditure by taxation or issuing bonds. Barro (1974) has shown that the Ricardian equivalence proposition may still apply even if the current generation

receives the tax cut and future generations bear the burden of repaying the government debt. The Ricardian proposition implies that deficit-financed government spending may have neutral impact in the long-run (Barro, 1989).

Ricardian equivalence requires assumptions that have been seriously challenged. Feldstein (1976) argued that Barro ignored economic and population growth. He demonstrated that the creation of public debt depresses savings in a growing economy. O'Driscoll (1977) opined that Ricardo, in expanding his treatment of this subject for an Encyclopedia Britannica article, changed so many features of it as to result in a Ricardian Nonequivalence Theorem. Ricardian equivalence has been the subject of extensive empirical inquiry (Briotti, 2005). Blanchard (1985) and Bernheim (1987) have argued against the Ricardian equivalence proposition. Abel and Bernanki (2001) have concluded that tax cuts that lead to increased government borrowing affect consumption and national saving, though the effect may be small because there are theoretical reasons to expect Ricardian equivalence not to hold exactly.

Since the influential paper by Barro (1974) there have been a large number of theoretical and empirical studies of the REH. Therefore, empirical tests of the REH become a necessity to arrive at some conclusion. Earlier studies have used single equation estimation based on ordinary least squares including at most a few lagged values of the consumption and income variables. It appears that non-availability of data determined the choice of estimation technique. Because of availability of long period and advanced econometrics notably time series econometrics techniques, it is agreeable that REH is examined from long-term perspective using more recent techniques of time series econometrics. The problem with the single-equation estimation methods is that these deal with the unidirectional influence of the regrossors upon the regressand. The use of simultaneous equation models also did not overcome the standard econometrics problems. The problems of short-run as well as long-run relationship (cointegration) and causality in the variables is addressed by the time series econometrics methods. We will get highly misleading results if we apply convential econometric methods to nonstationary data. This problem has been pointed in the literature on Ricardian Equivalence by Modigliani and Sterling (1990), Khalid (1996) among others.

Therefore, the purpose of the article is to present an empirical analysis of the Ricardian equivalence hypothesis (REH) to see its soundness and relevance for Pakistan for the period 1960–2009. We explore the time series properties in order o overcome the problems of spurious regression, simultaneity bias, and the use of nonstationary data.

Review of Studies

Barro (1974, 1976 ,1989) did not accept the assertion that the decision to finance government expenditure by issuing bonds instead of raising taxes should lead to increased private consumption because economic agents are expected to regard those bonds as net worth and therefore might be tempted to increase consumption. Barro argues that if certain (rigorous) assumptions are satisfied, the way governments finances its expenditure either way should not really affect consumers' decisions. This implies that there should be equivalence (Ricardian Equivalence) between the two different methods of financing. According to Barro the decision of the government to finance its expenditure by issuing bonds to reduce taxation should induce the consumers to save the tax cut and invest it the bonds in order to provide for future increase in taxation. Therefore they would increase their savings and not consumption.

If consumers regard the bonds as net worth and decide to increase consumption rather than savings, then the increased supply of bonds would force interest rates to rise in order to induce a higher demand for them. This increase in interest rates would lead to a substitution of private investment (crowding out) by government expenditure. This is characterized the Keynesian approach and is usually included in ISLM models. Knowing which of these two approaches is compelling is noticeably important since these have the implications for stabilizations policies.

The REH is based on restrictive assumptions—constant tax payers population, perfect capital markets, forward-looking rational economic agents; future income flows and future tax burdens are certain; and tax is collected as a lump-sum, etc. The theoretical studies have examined how the assumptions are realistic. Tobin (1980), Seater (1993), and others have shown doubts about the plausibility of the REH assumptions. Seater (1993) noted that Ricardian Equivalence is only an approximation and its real relevance for the behaviour of an economy is an empirical question. The evidence supporting or otherwise has not been found to be conclusive [see, for example, Baro (1989), Bernheim (1987), Seater (1993), Khalid (1996)].

Empirical evidence on REH is mixed. Some studies have provided support for it [Evans (1988), Seater (1993), Kormendi and Meguire (1990, 1996), Bayoumi and Masson (1998)]. Other studies provided evidence against it [Bernheim (1987), Modigliani and Sterling (1990), Feldstein and Elmendorf (1990), Dalamagas (1992)]. Graham and Himarios (1996) and Khalid (1996) found mixed evidence for a sample of developing countries.

Giorgioni and Holden (2001) argue that these empirical tests suffer from certain weaknesses because in these tests it has been implicitly assumed that fiscal policy is an exogenous instrument in the hands of governments implying that government expenditure is independent of the level of real income. However, this assumption needs to be tested against the alternative hypothesis of Wagner's law that government expenditure rises in line with (or more than) income.[3] Another unsettled issue is the relationship between government expenditure and gross domestic product. By extension, government consumption and investment on goods and services that are complementary will increase private consumption. Therefore, it is important to incorporate these inter-relationships among the different variables in the model.

The Model and Methodology

Since we will deal with time series data, it is necessary that time series properties of the variables under study are explored in order to overcome the problem of spurious regression as highlighted in literature. The examination of stationarity/nonstationarity is important before doing any empirical work which is closely linked to the tests for unit roots. A series is stationary if its mean, variance and covariance are time-invariant otherwise nonstationary. Cointegration may provide useful information about the relationship between the nonsatationary variables. The general requirement for applying the cointegration technique is to have variables of the same order of integration at hand. Therefore, acceptance of cointegration between two series implies that there exists a long-run relationship between them. To test the data series for unit roots, Augmented Dickey-Fuller (ADF) test is used which is based on the following regression:

$$\Delta Y_t = \psi + \gamma Y_{t-1} + \beta_t + \sum \beta_j \Delta Y_{t-j} + \varepsilon_t \qquad (1)$$

where ε_t is assumed to be Gaussian white noise, test statistics based on (1) is called the τ (tau) statistic. In the above regression equation the parameter of interest is g. If the computed $|\tau| <$ DF or MacKinnon critical τ values then we do not reject the hypothesis that H_0: $\gamma = 0$ and the given time series has unit root that is it is nonstationary or is integrated of order one or I (I) in Engle and Granger (1987) terminology. Now if Ho: $\gamma = 0$ is rejected, then first difference stationary is confirmed which means that the original time series is integrated of order one.

Two-step procedure of Engle and Granger (1987) is a simple and popularly used test of cointegration. However, this test is appropriate for bivariate models. We use the maximum likelihood procedure of Johansen (1991, 1995). If the series are not cointegrated, standard Granger causality can be used. This test is highly sensitive to the choice of lag length that can be decided using diverse criteria and for lag selection. Akaike information criterion (AIC), Schwarz information criterion (SIC) and final prediction error (FPE) are generally used. The reported F-statistics are the Wald statistics for the joint hypothesis.

Following Giorgioni and Holden (2001) our model consists of four variables-real gross domestic product (GDP), real private consumption (PC), real government expenditure (GE) and real government revenues (GR)– which have been commonly used in most empirical tests of the REH. Bernheim (1987) observed that many models attempting at estimating REH were miss-specified because these models used aggregate revenues rather than marginal rates of taxation. Besides Bernheim (1987) contends that budget deficits are relevant for the REH, and he does not approve the use of vectorautoregressions (VARs) for empirical examination of REH. VARs of differenced variables may be used but that have resulted in poor forecasting (Holden, 1995).

We use real values of the variables obtained by deflating the nominal variables by consumer price index. Non-availability of data prevented the inclusion of the wealth effect. Similarly, budget deficit has not been included due to presence of both government expenditure and government revenues.

We use an unrestricted vector autoregression (VAR) relating the four variables of interest. Holden (1995) and Robertson and Wickens (1994) noted that if all the variables are stationary, a VAR could be estimated. However, any shocks to stationary variables can only have a temporary effect. If the variables are not stationary and not cointegrated, the variables could be transformed to be stationary by taking first differences and the VAR could then be estimated with first differenced (now stationary) variables. However, a shock on a first-differenced variable will have a temporary effect on the change of the variable

and a permanent effect on its level (Giorgioni and Holden, 2001).

Therefore, the methodology consists of three steps. In the first step, we examine the variables for unit roots using ADF. In the second step, we use an unrestricted VAR comprising the underlying variables and determine the optimal lag length using three information criteria (AIC, FPE, SC). The third step involves the use of Johansen cointegration tests in order to see the presence of cointegration. If the variables are cointegrated, then an ECM exists based on Engle and Granger Representation theorem (1987, 225) otherwise we use Granger Causality test.

The data on the aforementioned four variables have been taken from Government of Pakistan, Economic Survey (various issues). We have used annual data because quarterly data were not available. The period of the study is from 1960–2009.

Empirical Results

We performed ADF test to check whether data series are stationary or not. Table 1 provides the ADF test results

Table 1: ADF Results

Variable	Level With Trend	P	Result	First Difference	P	Result
lny	–2.09 (0.5381)	2	NS	–7.07 (0.000)	1	S
lnrc	–1.58 (0.785)	2	NS	–8.08 (0.000)	1	S
lnrg	–2.32 (0.4116)	0	NS	–6.92 (0.000)	0	S
lnrgr	–2.98 (0.1358)	0	NS	–6.05 (0.000)	1	S

Note: Test critical values for 1%, 5%, and 10% are –4.17, –3.51, and –3.18. The trend and the figures in parentheses are MacKinnon (1996) one-sided p-values and p is the automatic lag length based on SIC (Schwarz Information criterion).

for level as well first difference. The results show that the variables are nonstationary or integrated of order 1 in level as well as first difference. The null hypothesis that the series has a unit root in level form is accepted as the absolute values of the *tau*- statistic are less than critical values. Similarly the null hypothesis that the series is first difference nonstationary is rejected because the absolute value of the τ-statistic exceeds the critical values for all the underlying variables coupled with significant MacKinnon (1996) one-sided p-values. Thus all the variables are nonstationary and have a unit roots. Before applying the Johansen test, we determined the lag order of our four variables VAR. Lag 1 was preferred by AIC, FPE and SC (Table 2).

Table 2: VAR Lag Order Selection Criteria

Endogenous variables: lny lnrc lnrg lnrgr Sample: 1960 2009

Lag	FPE	AIC	SC
0	2.40e–07	–3.891943	–3.732931
1	**1.16e–10***	**–11.53122***	**–10.73616***
2	1.89e–10	–11.05600	–9.624886
3	1.57e–10	–11.28631	–9.219148
4	2.58e–10	–10.87227	–8.169060

Note: * indicates lag order selected by the criterion

Since the three information criteria have indicated lag 1 for the VAR, we use the same lag for empirical examination. Johansen cointegration results (Table 3 and Table 4) show absence of cointegration between the four

Table 3: Johansen Cointegration Test Results
Series: lny lnrc lnrg lnrgr
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.187095	22.54742	47.85613	0.9678
At most 1	0.142467	12.60463	29.79707	0.9088
At most 2	0.097174	5.227230	15.49471	0.7842
At most 3	0.006653	0.320435	3.841466	0.5713

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
CE(s) = number of cointegrating equations

Table 4: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE (s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.187095	9.942788	27.58434	0.9857
At most 1	0.142467	7.377402	21.13162	0.9376
At most 2	0.097174	4.906795	14.26460	0.7536
At most 3	0.006653	0.320435	3.841466	0.5713

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

variables. We performed standard Granger Causality test. This test is sensitive to lag length. We used the three information criteria to determine the lag length and lag 1 was found optimal.

The Granger causality test results shown in Table 5 show that the null hypothesis that real income (y) does not Granger-cause real consumption, real government expenditure and real government revenue and government expenditure does not Granger-cause government revenue is rejected by the F-statistic at 5% level. These results imply that there is unidirectional causality from real income to real consumption, real government expenditure and real government revenue and from real government expenditure to real government revenue.

Table 5: Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Probability
rc does not Granger Cause y y does not Granger Cause rc	49	2.09533 5.27881	0.15453 0.02619
rg does not Granger Cause y y does not Granger Cause rg	49	0.01338 4.93752	0.90841 0.03124
rgr does not Granger Cause y y does not Granger Cause rgr	49	0.31515 3.27920	0.57726 0.07670
rg does not Granger Cause rc rc does not Granger Cause rg	49	0.44089 5.39578	0.51001 0.02466
rgr does not Granger Cause rc rc does not Granger Cause rgr	49	0.01805 2.32260	0.89370 0.13435
rgr does not Granger Cause rg rg does not Granger Cause rgr	49	4.11408 2.07065	0.04834 0.15693

Masih and Masih (1995) have pointed out two limitations of the Granger-causality tests. First, these tests do not indicate the positive or negative direction of response. Second is the fact that they can be interpreted as within-sample tests but might provide little evidence on the dynamic properties of the system. To solve these problems impulse response functions are used. An impulse response function traces out the response of the dependent variable in the VAR system to shocks in the error terms. We use the first differences of the variables because the variables are neither stationary nor cointegrated.

The results of impulse response functions indicate the impact of shock of one variable upon others (Table 6 and Table 7). We considered 10-periods that seem sufficient examining the effects of shocks. Because of income shock

Table 6: Impulse Response Functions: Cholesky Ordering: dln (income), dln (rc), dln (rg) dln (rgr)

(1) Response to one standard Deviation shock of dlny				
Period	**dlny**	**dlnrc**	**dlnrg**	**dlnrgr**
1	0.049710	0.000000	0.000000	0.000000
2	0.008299	–0.015606	0.007443	–0.008384
3	–0.025195	–0.010737	–0.011198	–0.010720
4	–0.005894	0.007709	–0.004856	–0.006194
5	0.007258	–0.002901	0.002927	0.009475
6	–0.000631	0.003272	0.004028	0.003574
7	–0.001045	0.007973	–0.004155	–0.002431
8	0.002071	0.002481	–0.002488	–0.004871
9	–0.003480	–0.003642	0.000965	0.000968
10	–0.002197	–0.001054	0.002001	0.001894
(2) Response to one standard Deviation shock of dln(rc)				
1	0.049903	0.029437	0.000000	0.000000
2	0.014874	–0.017973	0.011585	–0.006017
3	–0.033471	–0.008791	–0.016049	–0.017759
4	–0.010258	0.006834	–0.002803	–0.003115
5	0.013944	–0.003693	0.003233	0.010698
6	0.003875	0.000728	0.007504	0.006690
7	–0.003509	0.007702	–0.006563	–0.005644
8	0.001448	0.003707	–0.003552	–0.006314
9	–0.004535	–0.004833	0.001345	0.000995
10	–0.002841	–0.001561	0.003072	0.003786

Table 7: Impulse Response Functions: Cholesky Ordering: dln (income), dln (rc), dln (rg) dln (rgr) (3) Response to one standard Deviation shock of dln(rg)

Period	dlny	dlnrc	dlnrg	dlnrgr
1	0.034227	–0.051918	0.096972	0.000000
2	–0.011346	–0.012303	–0.009599	–0.004043
3	0.034160	–0.031874	0.009239	–6.75E–05
4	–0.004554	0.010199	–0.015329	–0.006682
5	–0.019055	0.014095	0.028146	0.015527
6	–0.011122	0.015009	–0.011782	–0.006526
7	0.005741	0.003704	0.005578	0.004272
8	–0.003688	–0.002436	–0.001875	0.002141
9	0.005539	0.002903	0.009608	0.007305
10	0.004507	–0.002072	–0.001665	–0.002929
(4) Response to one standard Deviation shock of dln(rgr)				
1	0.041287	–0.011602	0.028887	0.066832
2	–0.000840	–0.027265	0.014669	–0.008039
3	–0.020021	0.003330	–0.023599	–0.011205
4	–0.002614	–0.005364	0.004391	–0.009284
5	0.002038	–0.015576	0.007447	0.019737
6	–0.001185	0.001761	0.011740	0.004879
7	0.008243	0.004807	–0.010464	–0.001469
8	0.001972	0.002473	0.000981	–0.007496
9	–0.011271	–0.003753	–2.88E–05	0.002667
10	–0.002446	0.002013	0.004003	0.001274

(1), income falls in the second period; becomes negative in the third period and dies out in the remaining periods. The same pattern is observed for other three variables. For consumption shock (2), we see almost similar pattern. It becomes negative in the second period and dies out in the subsequent periods. Considering real government expenditure shock (3), real government revenue falls considerably in the third period but improves in period 5 and consequently dies out in the remaining periods. Real government revenue follows similar trend. The impact of both government expenditure and government revenue on consumption even in the first period is negative.

Figure 1 shows the above-mentioned responses to respective shocks. Shock to income due to consumption shock is noteworthy. It demonstrates a precipitate fall vis-à-vis expenditure and revenue shocks. Consumption falls appreciably due to expenditure and revenue shocks. This happens in the short-run. In the long-run they all almost converge. This implies that the shocks have not perennial effect. Economy possesses adequate resilience to absorb those shocks. However, in the short-run the shocks affect the economy to a greater extent. Therefore, macroeconomic stabilization policies are adopted that aim at averting those shocks that harm the economy substantially in the short-run that baulk the smooth functioning of the economy.

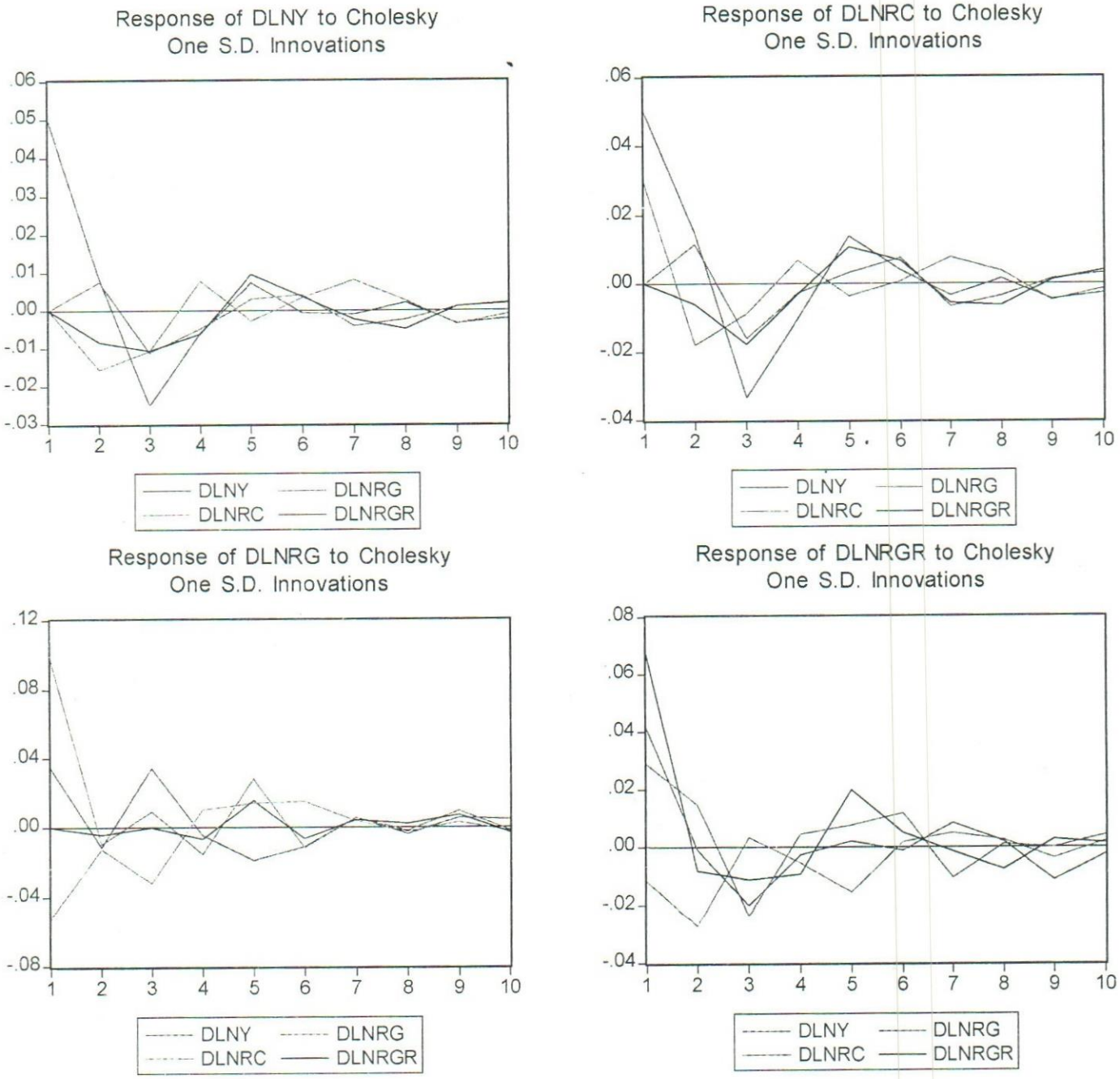

Figure 1

Conclusions

This article provides empirical evidence on the soundness and relevance of the Ricardian Equivalence hypothesis for Pakistan over the period 1960-2009. Time series properties have been examined in order to take care of the criticism made against the previous studies on REH notably model-specification, simultaneity bias and stationarity of data. Real income, real consumption, real government expenditure and real government revenue, though nonstationary, are not cointegrated implying that the long-run relationship does not exist among the variables

under consideration. Real income Granger causes real consumption, real government expenditure, and real government revenue. Government expenditure Granger causes government revenue. This means that there is unidirectional causality from real income to real consumption, real government expenditure and real government revenue and from real government expenditure to real government revenue.

Due to the problems associated with Granger causality, we used impulse response functions to ascertain the impact of shocks of one variable upon others. Similar patterns of shocks have been observed. However, the impact of real government expenditure and real government revenue on consumption is most notable and substantial. This happens in the short-run and these shocks have not perennial effect. Economy possesses adequate resilience to absorb those shocks. Therefore, stabilization policies are adopted that aim at averting those shocks that harm the economy substantially in the short-run that baulk the smooth functioning of the economy.

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Consult not your fears but your hopes and dreams. Think not about your frustrations, but about your unfulfilled potential. Concern yourself not with what you tried and failed in, but with what is still possible for you to do.

—Pope John XXIII

Feature

Production Variability in Jute Cultivation in Barpeta District of Assam—An Economic Analysis

G.K. SARMA AND D.C. KALITA

The study was conducted in Barpeta district of Assam to examine the current status of production technology adopted by the farmers in jute cultivation, fiber production variability between the size groups of farm, and factors affecting yield variability of jute crop. Random sampling technique was followed for selection of farmers and a total 105 sample farmers were selected from 15 villages from 3 development blocks of Barpeta district of Assam. The results of the study revealed that most of the farmers have adopted traditional methods of jute cultivation and a few have partially adopted improved methods. No farmer was found who adopted the full package of improved method of cultivation. It was observed the technical inefficiency of the farmers was the main cause of variation of yield between the farm's yield and the maximum potential yield. The result showed that technical increased with the increase in farm size. The factors determining variation in technical inefficiency were determined as operational size, number of adult family labor per hectare, and the total. adult family members.

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Jute is the second most important crop after cotton, both in terms of area and production in India as well as in the world. India ranks second next to Bangladesh in terms of production in the world. Till 1947, the production of jute was monopoly in agriculture sector, but after division of India into Pakistan and India, India retains most of the jute mills and major jute growing areas went to Pakistan. In India major jute growing states are West Bengal, Assam, Bihar, Orissa, Uttar Pradesh, Tripura, and Meghalaya. The climate of these states is suitable for luxurious growth of the crop. In Assam jute is grown mostly in lower Brahmaputra Valley zone, North Bank Plain zone, and Central zones. The area and productivity of jute from 2006–07 to 2008–09 gradually increased from 0.58 to 0.62 lakh hectare and 1744 to 2005 kg per hectare, respectively.

Jute is a labor intensive crop. It also generates paid employment to the extent of 11.1 million man days (Burger and Smith, 1985) and provides sustenance to 0.25 million industrial workers and about two million people in the secondary and tertiary sectors of the country. In case of Assam, more than 0.20 million farm families are directly involved in cultivation of jute out of which 80% are marginal and small. The present article is an attempt to examine *(i)* the current status of production technology used by the farmers, *(ii)* the productivity difference between the size groups of farms, and *(iii)* the factors affecting in yield variability in jute production.

Methodology

The present study was conducted in Barpeta district of Assam considering three community development blocks viz., Barpeta community development block, Bhawanipur community development block, and Chenga community

development block where jute crop is mostly grown. The lists of villages under each community development block were collected from the concerned Agriculture Development Officers. Random sampling technique was followed for selection of villages. Out of 379 revenue villages under the three community development blocks, total 15 villages were selected. Thus, each community development block covered 5 villages and 1 village was selected from one Agriculture Development Officer's circle. The list of households with respect to their operational holdings was prepared in consultation with the Agriculture Development Officer. 7 numbers of households were selected from each village. The households were selected randomly. Total 35 numbers of households from each development block were selected. Finally, from three community development blocks, total 105 households were selected. The selected farmers were then stratified into three groups viz., small (below 2 hectares), medium (2–4 hectares), and large (above 4 hectare) based on their operational holdings.

The data were collected with the help of pre-tested survey schedules with the help of personal interview method of sampling. Both tabular and functional analyses were carried out in the present study. The present status of production technology adopted by the farmers was derived by computing arithmetic average of the resource utilized for the production process. The Stochastic Production Frontier was used to evaluate the productivity difference between the size groups of farms. Linear regression method was followed to investigate the factors affecting in yield variability in jute.

Conceptual model and estimation procedure

The difference in yield between the size group of farms may arise from the three sources, such as:

1. due to the difference in technology used;
2. the farmers have excess to the same level of technology but all are not equally efficient using the available technology;
3. due to the effect of random factors which are beyond the control of the farmers.

Assuming the Cobb-Douglass production function, a Stochastic Production Frontier, which allows to investigate technical inefficiency of individual farmers, can be written as:

$$\text{Log}Y = \alpha + \Sigma \beta \text{Log}x + v\text{-}u \qquad (1)$$

where, Y = yield of jute fiber

x_j, j = 1, 2, 3, ...,n; stands for inputs used in jute production

β_j, j = 1, 2, 3, ...,n; are coefficient associated with input x_j

v = error term

u = random term having one sided distribution, and represent technical inefficiency

v = intercept

Estimation of u

The estimates of "u" in equation (1) can be obtained by the method given by Jondrow et al. (1989). They showed that the mean of "u" given (u + v) as:

$$E(u/v) = \mu - \frac{f(e\lambda/\delta)}{1 - F(e\lambda/\delta)} - \frac{e\lambda}{\delta} \qquad (2)$$

$$\lambda = \frac{\delta u^2}{\delta v^2}$$

$$\delta^2 = \delta u^2 + \delta v^2$$

$$\mu = \frac{\delta u^2}{.\delta v^2.\delta v^2}$$

δu^2 = variance of individual variability (u)

δv^2 = variance of random variability (v)

$\lambda > 1$ indicates that the variation in production is due to the technical inefficiency of the farmers while $\lambda < 1$ indicates that the variation in production is due to the random variability.

Results and Discussion

Current Status of Production Technology

The details of the production technology applied by the farmers are presented in Table 1. The average land used for jute cultivation by the sample farmers was 0.47 ha accounting 19.11% to the total cultivated area of the farmers. It was clear that average area under jute cultivation was found to be increased with the increase in size group of farmers. In case of sowing time, the sample farmers preferred to sow the seeds in the months of March and April. Usually, they started the sowing of seeds from end of March to end of April irrespective of the size group of farms, because during this period pre-monsoon showers

Table 1: Average Area under Cultivation and Practices Followed for Jute Cultivation by the Sample Farmers

Particulars	Small farmers (< 2 ha)	Medium farmers (2 – 4 ha)	Large farmers (> 4 ha)	All farms
Area under jute production (ha)	0.26 (19.40)	0.54 (20.22)	0.85 (17.78)	0.47 (19.11)
Seed treatment (No. of households)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Sowing time (No. of households)				
February	1 (0.01)*	3 (0.03)*	2 (0.05)*	6 (0.09)*
March	29 (0.15) *	26 (0.25) *	16 (0.44) *	71 (0.84) *
April	21 (0.11) *	27 (0.26) *	13 (0.36) *	61 (0.73) *
Sowing Method (No. of households)				
Broadcasting	47 (44.76)	39 (37.14)	19 (18.10)	105 (100.00)
Line	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Plant spacing (in inch)				
Lower limit	4.91	4.52	4.42	4.68
Upper limit	7.13	6.82	6.79	6.92
Seed rate (kg/ha)	14.82	15.49	13.70	14.82
Varieties used				
Only HYV	16 (34.04)	19 (48.72)	12 (63.16)	47 (44.76)
Both HYV and local	7 (14.89)	8 (20.51)	4 (21.05)	19 (18.10)
Only local	24 (51.06)	12 (30.77)	3 (15.79)	39 (37.14)
Interculture operation (No. of households)				
Manually	47 (44.76)	39 (37.14)	19 (18.10)	105 (100.00)
Improved practices	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Manure used (No. of households)	9 (19.15)	6 (15.38)	5 (26.32)	20 (19.05)
Chemical fertilizers used (No. of households)	32 (68.09)	34 (87.18)	17 (89.47)	83 (79.05)
Use of plant protection chemicals (No. of households)	12 (25.53)	11 (28.21)	12 (63.16)	35 (33.33)
Retting process (No. of households)				
Stagnant water	35 (74.47)	33 (84.62)	12 (63.16)	80 (76.19)
Flowing water	12 (25.53)	6 (15.38)	7 (36.84)	25 (23.81)
Drying method followed (No. of households)				
Sundry	47 (44.76)	39 (37.14)	19 (18.10)	105 (100.00)
Mechanical drying	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

Note: Figures in parentheses indicate percentage to the total
* Figures in parentheses indicate the area under cultivation (in hectare)

starts. All farmers have practiced broadcasting method of sowing of seeds. Since the crop was sown by broadcasting, so proper spacing was not maintained. The average plant spacing between plants ranged from 4.68 cm to 6.95 cm which was too dense as per our technology recommendation. The farmers think that the can get more production both in terms of fiber and fire wood when they grow the crop in a narrow spacing. If we see the seed rate, the quantity of seeds used by sample farmers (14.82 kg/ha) was almost double than the recommendation. No farmer treated the seeds with fungicides or any plant protection chemicals before sowing. Farmers used both the HYV seeds as well as the local seeds. They preferred to grow the *Corchorus olitorious* varieties because the thinned out plants can be consumed as vegetable. Moreover a minimal return can be obtained when sold in the market as vegetable. Table 2 reveals that 44.76% farmers used only HYV of jute, 18.10% farmers used both HYV and local seeds, and 37.14% farmers used only local varieties of seeds. The percentage of adoption of only HYV farmers increased with the increase in size group of farmers. The inverse trend was observed in case of adoption of local varieties of seeds. Interculture operations, like weeding, thinning, etc., were done by using traditional implements such as khurpi and *bindha* by all the farmers irrespective of size groups. Since the farmers sowed the seeds by broadcasting method, there were no alternatives to use the other improved implements. 19.05% of the total sample farmers used cow dung in their crop fields and 79.05% farmers used chemical fertilizers. The quantity of manures and fertilizers used in the crop field was not sufficient and no farmer was found who applied the manures and chemical fertilizers as per recommendation. The table also reveals that with the increase in the size group of farmers there was increase in application of manures and chemical fertilizers. The same case was observed in case of use of plant protection chemicals. Only 33.33% farmers used plant protection chemicals. Large farmers used highest percentage (63.16%) of plant protection chemicals to save the crop from the insect, pests, and diseases. In case of retting process, 76.19% farmers retted the crop for fiber extraction in the stagnant water and the remaining 23.81% farmers retted the crop in running water, that is, in the river and small stream.

Productivity difference between the size groups of farms

The productivity difference between the size groups of farms is presented in Table 2. The table clearly shows that the productivity of all categories of farmers was less than the potential yield and the productivity of farms increased with increase in farm size. It was mainly due to the fact of better cultural practice, use of more HYV seeds, use of higher dose of manure and chemical fertilizers in comparison to the small farmers.

Table 2: Productivity difference of jute fiber between size groups of farms

Particulars	Small farmers (< 2 ha)	Medium farmers (2 – <4 ha)	Large farmers (> 4 ha)	All farms
Productivity (qt per hectare)	16.05	18.88	21.69	19.10

Technical efficiency between size groups of farms

The mean value of technical inefficiency for different size groups of farms as well as the entire sample is presented in Table 3. The table shows that the mean of technical inefficiency increased with the increase in farm size. The large size group of farms scored the highest mean (3.5771) where as the small size group scored lowest mean (2.0108) which implied that the mean technical inefficiency was highest in the large size groups and the lowest in the small size group of farms. The probable reason of such variation in technical inefficiency might

Table 3: Mean Technical Inefficiency in Different Size Groups of Farms

Particulars	Small farmers (< 2 ha)	Medium farmers (2 – <4 ha)	Large farmers (> 4 ha)	All farms
Mean	2.0108	2.9751	3.5771	2.6524
Standard Deviation	0.70908	0.73077	0.74253	0.94565

be due to that the plant protection chemicals, manures and fertilizers, operational size, hired labor, family labor were used by the large size groups more than the small farm size groups. From the entire sample average, it was observed that the technical inefficiency was 2.6524 which was less than that of medium and large size groups of farms. The increase of technical inefficiency with the increase in size groups of farms was probably due to the effect of the random factors which were beyond the control of the small farmers.

Factors affecting in yield variability in jute

The factors responsible for yield variability in jute are presented in Table 4. The factors namely, operational size, number of family labor per hectare, number of adult family labor (above 15 years) had significant bearing on technical inefficiency in jute production in the study area. Illiteracy was not significant at any probability level, but the coefficient was positive which indicated that with the increase in illiteracy of farmers there was increase in technical inefficiency.

Table 4: Factors Affecting in Yield Variability in Jute

Variables	Units	Coefficients
Intercepts	–	1.65198 (0.170285)
Illiteracy	–	0.0105944 (0.0232045)
Operational size	Hectare	0.474453* (0.0495725)
Family labor	Number per hectare	0.000962821*** (0.000651675)
Adult family member	Number	−0.0624203** (0.0240944)

Note:a. Figures in parentheses indicate asymptotic standard errors at estimates
b. * significant at 1% probability level
c. ** significant at 5% probability level
d. *** significant at 15% probability level

The operational size of farmers was highly significant at 1% probability level and its coefficient was positive. It clearly indicates that with the increase in operational size of holdings, there is increase in technical inefficiency. The number of family labor per hectare was significant at 15% probability level and the coefficient was positive. Thus, there is increase in technical inefficiency with the increase in number of family labor per hectare. The number of adult family labor (above 15 years) showed the significant effect at 5% probability level, but the coefficient was negative which meant that there was a positive correlation with production. That is, with the more use of adult family labor in the farm work, there was decrease in technical inefficiency. It clearly indicates the there was disguised unemployment in case of family labor.

Conclusion

From the above discussion it is clear that the farmers have not yet adopted full package of practices of jute cultivation. The large farmers adopted the package of practices to some extent in compare to the small size group of farmers for which they gained better yield than the small farmers. The average yield gained by the farmers was too low than the potential yield and the productivity of farms increased with increase in farm size. Though there are so many factors responsible in productivity of the crop, yet statistical analysis showed that only few factors such as operational size, number of family labor per hectare, number of adult family labor (above 15 years) had significant affect on productivity of jute crop. Thus, we can conclude that there is a great opportunity to increase the farm productivity with proper use of all farm inputs.

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The most important factor for motivation is goal setting. You should always have a goal.

—Francie Larrieu Smith

Feature

Rice Economy of Tamil Nadu

T.R. SHANMUGAM AND M.UMAGOWRI

The present study was conducted with an aim to explore rice economy in India. The study has further explored the trends in rice area, production, and productivity. The analyses had revealed that demand for rice is growing with ever-increasing population. The study was able to finally conclude that the land is more inelastic in nature: the only option available to step up food production by increasing productivity through appropriate farm strategies, that is, system of rice intensification which will ensure the food security for the increasing population.

Rice is life for millions of people in the world which includes most of the developing countries. It is the second largest produced cereal in the world and is the main cereal for majority of the population in India. Global demand for rice and its high price have put a lot of pressure on rice-producing countries. At the beginning of the 1990s, world annual rice production was around 350 million tons and by the end of the year 2008–09, it reached 447 million tons. Yet the demand for rice is growing with ever-increasing population. The world population is projected to increase 40% by the year 2020 and the increased demand for rice is expected to exceed production in many countries in Asia, Africa, and Latin America. World rice production therefore needs to increase, while land, water, and labor are all decreasing. Improving the productivity of rice systems would contribute to hunger eradication, poverty alleviation, national food security, and economic development. However, rice production is facing serious constraints including a declining rate of growth in yields, depletion of natural resources, labor shortages, gender-based conflicts, institutional limitations, and environmental pollution. The diversity of the regions, peoples, and resources connected within the world's rice-based systems, requires a diverse approach for global rice-based development that includes participation from the local to the international level. The objectives of the present study is *(i)* to analyze the trends of rice production in India and Tamil Nadu; *(ii)* to estimate the Compound Growth Rate of area, production and productivity in India and Tamil Nadu; *(iii)* to study and compare the cost of cultivation of conventional rice and System of Rice Intensification; *(iv)* to suggest suitable policy options for increasing productivity of rice.

Methodology

The present study had utilized both primary and secondary

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export, and import of world and India were compiled from international rice research institute from the year 1970 to 2009. The secondary data was analyzed using the regression analysis and compound growth rate techniques to draw meaningful inference. Data regarding cost of cultivation were collected from the primary survey in the Sathyamangalam taluk in Tamil Nadu during 2009–2010, which has more number of rice farmers practicing SRI and conventional method of rice cultivation. The study covered both conventional and SRI farmers, 60 farmers from each category, totaling to about to 120 farmers. The sample farmers were contacted personally and the data were collected from them on input usage and the data on cost and returns using structured questionnaire.

Indian Rice Scenario

Rice production in India is an important part of the national economy. Food Corporation of India purchases around 20 to 25% of the total rice production in the country both under levy from the rice mills and directly in the form of paddy from the farmers at Minimum Support Prices announced by the Government. Currently India has a buffer stock of 26.2 million tones, which is thrice that of the normal requirement of 12 million stocks, which indicates a higher scope for export. India's population is expected to be 1.2 billion by 2012. The demand for rice in India is projected at 128 million tones for the year 2012 and will require a productivity level of 3,000 kg/ha significantly greater than the present average yield of 2178 kg/ha.

India is the world's second largest producer of white rice, accounting for 227% of all world rice production, preceded only by China. India's annual rice production is around 85–90 million tones. Over a 40 years period rice area increased by 20% but increase during 2000s much less at 1.43% compared to over 6% in 1970 and 80's. But production is more than doubled due to share increase in productivity (95% increase) which indicates the scope to increase the yield levels. In Future, there is no scope to increase the area under cultivation. Only increase in productivity can make the production to go up (Table 1).

Table 1: Decadal changes in India

Year	Area		Production		Productivity	
	Million ha	Change (%)	Million tones	Change (%)	Kgs/ ha	Change (%)
1970–71	37.59	–	42.22	–	1123	–
1980–81	40.15	+6.81	53.63	+27.02	1336	+18.96
1990–91	42.69	+6.32	74.29	+38.52	1740	+30.23
2000–01	44.71	+4.73	84.98	+14.38	1901	+9.52
2008–09	45.35	+1.43	99.15	+16.67	21.86	+14.99

More than 50% of total production comes from the four states namely West Bengal, Uttar Pradesh, Orissa, Chattisgarh, West Bengal tops both in area as well as the production. However, it is Punjab which leads with a productivity of 4022 kg/ha in India. Within the country, rice occupies one-quarter of the total cropped area, contributes about 42% of total food grain production and continues to play a vital role in the national food and livelihood security system.

Worldwide, India stands first in rice area and second in rice production, after China. It contributes 22.7% of global rice production. Among the exporting countries, Thailand, Vietnam, India and Pakistan are the major countries exporting rice in sizeable quantity. However, India did not become a major rice exporting country for a long time.

Table 2 shows that the quantum of export started to grow, from 0.015 million tones in 1970–71 to a record 4.74 million tones in 2008–09, next to Thailand (9.5 million tones) and Vietnam (5.2 million tones), One of the reasons for India to be the third largest exporter, after Thailand and Vietnam, is that it had to export rice to the neighboring Bangladesh and African countries on humanitarian grounds.

Table 2: Rice Export Scenario

Year	Production		Export	
	Million tones	Change (%)	Million tones	Share of export to production (%)
1970–71	42.22	–	0.015	0.04
1980–81	53.63	+27.02	0.963	1.80
1990–91	74.29	+38.52	0.678	0.91
2000-01	84.98	+14.38	2.193	2.58
2008–09	99.15	+16.67	4.739	4.78

Export as a share of Production increased from 0.04% to 4.78% in 40 years' period. Export quantity also increase to a tune of more than 300%. Rate of increase is higher in the later period which indicates the scope for further increase in the immediate future. Production of rice for export beside local consumption is also important.

Table 3: Decadal Changes in Tamil Nadu

Year	Area Million ha	Production Change(%)	Productivity Milliontones	Change (%)	Kg/ha	Change (%)
1970–71	2.53	–	3.66	–	1450	-
1980–81	2.51	–0.79	5.68	55.19	2265	56.21
1990–91	1.85	–26.29	5.78	1.76	3116	37.57
2000–01	2.08	12.43	7.36	27.34	3541	13.64
2008–09	2.07	– 0.48	6.46	–12.23	3120	-11.89

Results and Discussion

Tamil Nadu has a total geographic area of 13.02 million hectares. The total cultivable area is 7.55 million hectares which is about 58% out of the total geographic area. The area under paddy cultivation is 1.93 million hectares which accounts for about 25% of the state cultivated area. Water and labor shortages are the major constraints in rice production in Tamil Nadu.

Decadal changes in Tamil Nadu are given in Table 3. In Tamil Nadu the area under rice cultivation declined over years. The yield levels also remain fluctuated over the years. Even while average yield of Tamil Nadu is higher than all India, variety or yield increasing technology are to be evolved to enhance yield level consistently.

There are lot of fluctuations in the compound growth rate over the years from 1971 to 2009 and in the present trend (that is) 2000 to 2009 the area growth rate is in decreasing trend for both India as well as Tamil Nadu, Where as Production and yield are in the increasing trend for India and it is in the decreasing trend for Tamil Nadu (Table 4).

Table 4: Compound Growth Rate (1991–2009)

Region	Area	Production	Productivity
India	0.18	1.35	1.17
Tamil Nadu	–139	–2.19	–0.80

SRI is an acronym for System of Rice Intensification. This improved method of rice cultivation was developed in 1983 in Madagascar and has now spread too many parts of the world. SRI method of cultivation produces higher yields with less seed and less water. SRI emphasizes on the need to shift from chemical fertilizers to organic manures. SRI is not a new variety or a hybrid. It is only a method of cultivation.

SRI is showing promising results in all rice varieties—local or improved. SRI method is emerging as a potential

Table 5: SRI Districts in India

STATE	SRIDistricts	State	SRIDistricts	State	SRIDistricts
Andaman & Nicobar	2/3	Jammu & Kashmir	23/30	Orissa	0/8
Andhra Pradesh	22/23	Jharkhand	1/14	Pondicherry	2/4
Arunachal Pradesh	0/16	Karnataka	14/22	Punjab	7/20
Assam	2/24	Kerala	23/28	Rajasthan	0/32
Bihar	9/39	Madhya Pradesh	6/14	Sikkim	2/4
Chhattisgarh	4/18	Maharashtra	30/48	Tamil Nadu	31/32
Goa	0/4	Manipur	3/35	Tripura	4/4
Gujarat	6/25	Meghalaya	2/9	Uttar Pradesh	13/70
Haryana	6/20	Mizoram	4/7	Uttarakhand	13/13
Himachal Pradesh	6/12	Nagaland	0/8	West Bengal	11/18

Table 6: Comparison of Cost of Production

B			Conventional	System of Rice Intensification	
Sl.No.	Cost components Variable Cost	Value	% to the total	Value	% to the total
1	Human labor	16112.92	43.83	2038.72	52.89
2	Animal labor	1414	3.85	3357.39	8.72
3	Machine Power	6927.85	18.85	4083.07	10.6
4	Total Labor	23454.77	63.8	27823.18	72.19
5	Seed	3303.1	8.99	313.48	0.82
6	Manures and Fertilizers	3822.06	10.4	3795.49	9.85
7	Plant protection	2476.65	6.74	1667.16	4.33
8	Irrigation	2468.54	6.72	1668.75	4.33
9	Working capital	35525.12	96.62	36021.14	93.46
10	Interest on working Capital	1243.379	3.39	1260.74	6.55
	Total Variable cost	36768.5	100	37281.88	100

alternative to traditional way of flooded rice cultivation and is showing great promise to address the problems of water scarcity, high energy usage, and chemicalization. SRI districts in India are given in Table 5.

Comparison of cost of production in rice and output ant returns is given in Table 6 and Table 7, respectively. It shows that the yield difference between System of Rice Intensification and Conventional method of rice cultivation is 2.04 t/ha which is 41% higher than the conventional method of rice cultivation. System of Rice Intensification does not depend on purchased, external inputs. Instead, it increases the productivity of the land, labor, water and capital devoted to irrigated rice production by capitalizing on existing genetic potentials and by biological processes, particularly in the soil. System of Rice Intensification achieves these improvements in yield and factor productivity by changing some of the plant, soil, water and nutrient management practices.

Table 7: Output and Returns

Sl. No	Components	Conventional Rice	System of Rice Intensification
1	Main product (Qtls)	49.4	69.87
2	Value of main product (Rs)	47522.8	67214.94
3	Value of By product (Rs)	2956	3623.27
4	Gross Income	50478.8	70838.21
5	Net income over Operational cost	13710.3	3356.33
6	Input–output ratio	1.372882	1.900071

The yield difference between System of Rice Intensification and Conventional method of rice cultivation is 2.04T/ha which is 41% higher than the conventional method of rice cultivation.

Summary

The demand for rice is growing with ever increasing population. As the land is mostly inelastic in nature, the area under cultivation cannot be increased beyond certain limit. Hence the only option available is to set up food production by increasing productivity is through appropriate farm strategies say system of rice intensification, which will ensure the food security for the increasing population. Technological interventions specifically System of rice intensification increases the yield over 30% and also increases the efficiency levels in use of labor, seed, manure, fertilizer and other inputs. Increased mechanization in rice farms in view of higher wages and declining labor availability.

Varieties suitable to water stress, drought conditions, and short duration will help increase average yields and also varieties suitable for export, because rice continues to be one of the most protected traded commodities, it presents considerable scope for further market liberalization. However, because of its importance for food security, income generation and political stability, governments are often reluctant to loosen their control over the sector. Moreover, rice is at the core of the concepts of food security and multi-functionality that a number of countries are promoting for consideration in the ongoing round of multilateral trade negotiations. Hence to overcome all these only means available is to increase the productivity of rice through the available improved technologies.

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The more effort you put into something, the more you get in return.

—Dwight Rivera

Feature

Technical Efficiency in Crop Production and Dairy Farming in Punjab: A Zone-wise Analysis[1]

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The present investigation undertaken in the Punjab state has estimated the technical efficiency in crop production and dairy farming. A Frontier Production Function has been estimated by the method called Corrected Ordinary Least Squares. Efficiency indices of input use by the farms have been constructed using Timmer's Measure of Technical Efficiency. The technical efficiency has shown variation across the zones. Both in the case of crop production as well as dairy farming, the average technical efficiency has been found maximum in Central-plain Zone followed by South Western Zone and Sub-mountainous Zone.

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In the developing economies of the third world, agriculture contributes a major share to development. India, being a developing economy, is no exception. Agriculture not only provides food and raw material but also employment opportunities to a very large proportion of population. In Punjab about two-third of population lives in rural areas and is mainly dependent on agriculture. The new farm technology envisaged high yielding varieties, assured irrigation, use of chemicals, etc., has shifted the agricultural production function upward in the state. However, to achieve the higher levels of productivity, the intensity of the input use increased significantly over the years. Although, it increased the productivity, at the same time, the cost of production increased considerably. Further, overuse of resources specially land, water and chemicals have significant pressure on natural resource front and became cause of some prominent environmental issues. To add, the crop productivity for the principal crops since 2000–2001 has been observed to be stagnating despite increased use of inputs. In this context, the study of input use efficiency govern a special importance to determine whether there exists an unexploited potential for increasing farm incomes by optimizing the use of various inputs. So, in this study an attempt has been made to find out the technical efficiency of farms in different agro-climatic zones of Punjab.

Methodology

Data Collection and Sampling

In order to capture the spatial variation, Punjab state has been divided into three homogeneous agro-climatic

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zones, namely, Sub-mountainous Zone (18.5%), Central Plain Zone (55.0%), and South-western Zone (20.0%) based upon the cropping pattern, soil type, physiography, water availability, etc. It was noticed that each one of the zone is quite homogeneous in terms of cropping pattern and agricultural problems and potentials. For the purpose of drawing a sample, three stage random sampling was used with development block as first stage unit, village as the second stage unit and operational holding as the third stage unit. Ten primary sampling units (development blocks) were selected randomly from different zones in proportion to the total area of the respective zone in the state. Thus, by this way two blocks from Zone I, six blocks from Zone II, and two blocks from Zone III were selected. From each selected block two villages were selected randomly. All the operational holdings were enumerated and classified into five size classes namely marginal (< 1 hectare), small (1–2 hectare), semi-medium (2–4 hectare), medium (4–6 hectare) and large (≥ 6 hectare) in each sample village. From each selected village fifteen holdings were selected randomly. The number of holdings in each size class was selected in proportion to the total number of holdings falling in the respective size class. By this way the number of farms of different size categories selected from various zones are given in Table 1.

Efficiency Indices of input use by the farmers were constructed using Timmer's Measure of Technical Efficiency (Timmer, 1971). For this purpose Cob-Douglas/ Log-linear production function was fitted to the data.

The production function estimated for crop production is specified as under:

$$\log Y_c = \log a_c + b_{1c} + \log X_{1c} + b_{2c} \log X_{2c} + b_{3c} + \log X_{3c} + b_{4c} \log X_{4c} + b_{5c} \log X_{5c} + b_{6c} \log X_{5c} + b_{7c} \log X_{7c} + u_c$$

where,

Y_C = Gross value of produce of all the crops grown on a farm in an agricultural year in ' per farm

X_{1C} = Size of the operational holding in hectares

X_{2C} = Value of the seeds used for all the crops grown on a farm in an agricultural year in '

X_{3C} = Value of total fertilizers (N+P+K) applied to all the crops grown on a farm in '

X_{4C} = Total human labour employed on a farm in hours for cultivation of crops

X_{5C} = The value of total insecticides and pesticides used on the farm in a year for control of insect-pests and diseases in '

X_{6C} = The tractor use in hours on a farm for cultivation of crops

X_{7C} = Total use of tube wells in hours for irrigation on a farm.

The production function estimated for dairy farming is specified as under:

$$\log Y_D = \log a_D + b_{1D} + \log X_{1D} + b_{2D} \log X_{2D} + b_{3D} + \log X_{3D} + b_{4D} \log X_{4D} + b_{5D} \log X_{5D} + b_{6D} \log X_{6D} + b_{7D} \log X_{7D} + u_D$$

where,

Y_D = Gross value of milk produced on a farm in an agricultural year in '

Table 1: Number of farmers pertaining to each zone in the sample.

Zone	Size Category					
	Marginal (< 1 ha)	Small (≥1 < 2)	Semi-medium (≥2 < 4)	Medium (≥4 < 6)	Large (≥ 6)	Total
I	15	11	13	15	6	60
II	25	38	51	30	36	180
III	9	13	20	6	12	60
Overall	**49 (16.33)**	**62 (20.67)**	**84 (28.00)**	**51 (17.00)**	**54 (18.00)**	**300 (100.00)**

X_{1D} = Number of milch animals i.e. herd size on a farm.

X_{2D} = Total quantity of green fodder fed in kilograms to all the milch animals on a farm in a day.

X_{3D} = The total quantity of dry fodder fed in kilograms to all the milch animals on a farm in a day

X_{4D} = The total quantity of concentrates fed in kilograms to all the milch animals on a farm in a day

X_{5D} = Total hours of labour employed for dairy farming in a day.

X_{6D} = The total expenditure in ' incurred on purchase of medicines, doctor services, etc., on a farm for milch animals in a day.

The independent variables were tested for stochastic independence.

From the fitted regression equation the Frontier Production Function was derived by the method called Corrected Ordinary Least Squares. The procedure involved the estimation of the individual specific error terms from the estimated production function and then shifting the intercept by the magnitude of the largest positive error term, so that no other residual was positive. This resulted in output magnification not only at the particular point but over the entire production surface. This shifted function was the frontier function of the general form:

$$\hat{Y} = f(X)e^{u} \qquad u \leq 0$$

$\hat{Y}$ represents the maximum obtainable gross value produce for a given level of inputs

The maximum obtainable gross value produce for all the sample farms were calculated using the frontier production function. Technical efficiency of farm "i" is the ratio of actual value of produce to its potential value, given the level of input use on farm "i." Thus technical efficiency (TE) for each farm was obtained as:

$$T.E_i(\%) = \frac{Y_i}{\hat{Y}_i} \times 100 \quad \text{Where } i = 1, 2, 3, \ldots, n$$

where

Y_i - *Value of Gross Produce*

$\hat{Y}_i$ = *Potential Value of Gross produce*

Results and Discussion

The results obtained from the analysis of data are discussed in different sub-heads as under:

Production Function Estimates

(a) Crop Production

The Cobb-Douglas production function estimates for crop production in different zones of Punjab have been given in Table 2. In the Sub-mountainous Zone, size of the farm,

Table 2: Factors affecting gross value produce from crops in different zones of Punjab.

Particulars	Zone		
	I	II	III
Constant	0.6137 (0.25)	1.9657 (1.22)	0.5718 (0.37)
Farm Size (ha)	0.4661** (0.21)	1.3761** (0.54)	0.6038** (0.24)
Seed (')	0.1247 NS (0.08)	–0.6918 NS (0.60)	0.5422*** (0.18)
Fertilizers (')	0.2167** (0.09)	0.0597** (0.02)	–0.3811** (0.16)
Human Labour (hr.)	1.0957*** (0.33)	0.2852 NS (0.20)	0.1995 NS (0.12)
Insecticides, etc (')	0.1410 NS (0.11)	–0.4359*** (0.16)	–0.4439*** (0.13)
Tractor Use (hr.)	0.1578 NS (0.12)	0.0216 NS (0.02)	0.3076 NS (0.19)
Irrigation Machinery (hr.)	0.4869** (0.19)	0.3661*** (0.12)	0.1468 NS (0.08)
R^2	0.8267	0.8309	0.7442

Note: *** and **: significant at 1 and 5% level, respectively. NS: Non-significant.
Figures in parentheses are standard errors.

quantity of fertilizers applied, employment of human labour and availability of irrigation machinery has contributed significantly to the gross value of produce from crops. The gross value of produce responded highest to the change in human labour employment. With 1% increase in human labour employment, the gross value produce increased by 1.09%. This shows that human labour acted as a constraint in this zone. This might be due to the fact that in the Sub-mountainous Zone, because of its topography and scattered and fragmented land holdings, mechanization is not possible and most of the farm operations are performed manually. In the Central-plain Zone production responded significantly and positively to farm size, fertilizer

use and availability of irrigation machinery. It indicates that there is scope for improving the gross returns by increasing the level of these inputs. The coefficient of expenditure on insecticides was negative and significant at 1% level of significance, indicating its excessive use by the farmers of this zone. In the South-western Zone, the coefficient of seed rate was 0.5422 and significant at 1% level, indicating that the higher use of this variable will add to the gross returns from crop production in this zone. The coefficients of fertilizers use and insecticides use were –0.3811 and –0.4439, which were significant at 1 and 5% level. It indicates that the increased use of these inputs will rather exert negative impact on the gross returns. The reason behind this might be that the farmers of this zone were already using very high doses of these inputs for the crop production.

(b) Dairy Farming

The estimates of the Cobb-Douglas Production Function for dairy farming in different zones of Punjab have been presented in Table 3. The results show that in the Sub-mountainous Zone number of milch animals, quantity of green fodder fed, quantity of concentrates fed and expenditure on veterinary care were the factors which contributed significantly to the milk production. The milk production responded highest to the quantity of concentrates fed to the animals. With 1% increase in the quantity of concentrates fed, the gross value of milk produced increased by 0.95%. The coefficient of human labour has been found negative but non-significant. The results revealed that in the Central-plain Zone, milk production responded significantly and positively to the number of milch animals, quantity of green fodder fed, quantity of concentrates fed and expenditure on veterinary care. In the South-western Zone again the coefficients of above mentioned inputs were significant. It indicates that there is room for increasing gross returns from dairy farming by increasing the level of these inputs.

Table 3: Factors affecting gross value produce from dairy farming in different zones of Punjab

Particulars	Zone		
	I	II	III
Constant	0.7622 (0.57)	0.9172 (0.60)	0.4863 (0.35)
Milch Animals (No.)	0.6182** (0.28)	0.8206** (0.34)	0.5917** (0.27)
Green Fodder (kg/day)	0.3364** (0.16)	0.3813** (0.17)	0.4234** (0.18)
Dry Fodder (kg/day)	0.1167^{NS} (0.09)	–0.1468^{NS} (0.13)	–0.0958^{NS} (0.07)
Concentrates (kg/day)	0.9452*** (0.32)	0.5916*** (0.19)	0.4962*** (0.14)
Human Labor (hrs/day)	–0.1723^{NS} (0.11)	–0.1785^{NS} (0.10)	–0.1481^{NS} (0.12)
Veterinary Care (Rs/day)	0.3318*** (0.09)	0.3955*** (0.12)	0.5935*** (0.14)
R2	0.7054	0.7685	0.6884

Note: *** and ** : significant at 1 and 5% level, respectively.
NS: Non-significant.
Figures in parentheses are standard errors.

Technical efficiency

(a) Crop production

The Frontier Production Functions for different agro-climatic zones derived by the method of corrected ordinary least squares shifted the intercepts of the estimated production functions to 1.22 from 0.61 in Zone-I, 2.26 from 1.97 in Zone-II and 1.00 from 0.57 in Zone-III. The results related to technical efficiency in crop production on sample

Table 4: Technical efficiency in crop production on farms of different Zones of Punjab.

Technical Efficiency (%)	Zone-I		Zone-II		Zone-III	
	No.	Percent	No.	Percent	No.	Percent
< 25	5	8.33	9	5.00	2	3.33
³ 25 < 50	16	26.67	27	15.00	13	21.67
≥ 50 < 75	26	43.33	52	28.89	31	51.67
≥ 75	13	21.67	92	51.11	14	23.33
Average TE (%)	57.08		69.03		61.25	

farms in various agro-climatic zones have been presented in Table 4. It can be seen from Table 4 that in the case of Zone-I (Sub-mountainous Zone), 8.33% farmers were having technical efficiency upto 25%, while 26.67, 43.33 and 21.67% farmers were using their resources with efficiency ranging between 25 to 50, 50 to 75 and more than 75%, respectively. The average technical efficiency of the farms in Zone-I came out to be 57.08%. In the case of Zone-II (Central-plain Zone), 5% farms were using their resources with efficiency less than 25%, while efficiency of 15% farms ranged between 25–50%, 28.89% farms between 50–75% and 51.11% farms were in upper efficiency range of more than 75%. The average technical efficiency for the farms of central plain zone came out to be 69.03%. While the proportion of farms of Zone-III (South Western Zone) operating in various technical efficiency ranges of upto 25, 25 to 50, 50 to 75 and 75 to 100% was 3.33, 21.67, 51.67 and 23.33%, respectively.

The distribution of sampled farms according to the level of technical efficiency in crop production in different zones is presented in Table 5. It can be seen from Table 20 that the average technical efficiency of top 10% farms of zones I, II, and III was 77.61, 92.54 and 82.53%, respectively. Similarly, the corresponding figures for top 50% farms of various zones were 51.18, 76.23 and 59.56%, respectively. It is clear from the results that farmers of Zone-II were most efficient in using their existing resources followed by the farmers of Zone-III and Zone-I. This can be attributed to the fact that the soil, water and climatic conditions in Zone-II are more favorable for agriculture. Further, farmers of this zone are having better excess to extension and research agencies.

Table 5: Distribution of selected farms according to the level of technical efficiency in crop production in Punjab.

Percent of Farmers	Technical Efficiency (%)		
	Zone-I	Zone-II	Zone-III
Top 10	77.61	92.54	82.53
Top 20	68.24	87.68	77.81
Top 30	62.53	81.23	71.34
Top 40	57.24	78.64	64.47
Top 50	51.18	76.23	59.56

(b) Dairy farming

The frontier production function derived for estimating technical efficiency in dairy farming shifted the intercepts of the estimated production functions from 0.76 to 1.37 in Zone-I (Sub-mountainous Zone), 0.92 to 1.19 in Zone-II (Central-plain Zone) and 0.49 to 0.93 in Zone-III (South Western Zone). The estimates of technical efficiency in dairy farming on sample farms in various agro-climatic zones have been shown in Table 6. The examination of technical efficiency of individual farms revealed that in the case of Zone-I, 6.67% farmers used existing recourse with efficiency less than 25%, while efficiency of the 25, 45 and 23.33% farms was in the range of 25 to 50, 50 to 75 and more than 75%, respectively. The average technical efficiency of the farms of Sub-mountainous Zone came out to be 58.75%. In the Central Plain Zone the proportion of less efficient farms with technical efficiency less than 25% was 3.89%, while 15.56, 27.78 and 52.78 farms were operating in efficiency range of 25 to 50, 50 to 75 and more than 75%, respectively. The average technical efficiency of the farms of Zone-II was 69.86%. In the case of South-western Zone 1.67% farms were using their existing resources with efficiency less than 25%, while 21.67, 51.67 and 25% farms were using their existing

Table 6: Technical efficiency in dairy farming in different Zones of Punjab.

Technical Efficiency (%)	Zone-I		Zone-II		Zone-III	
	No.	Percent	No.	Percent	No.	Percent
< 25	4	6.67	7	3.89	1	1.67
≥ 25 < 50	15	25.00	28	15.56	13	21.67
≥ 50 < 75	27	45.00	50	27.78	31	51.67
≥ 75	14	23.33	95	52.78	15	25.00
Average TE (%)	58.75		69.86		61.88	

resources with efficiency in the range of 25 to 50, 50 to 75 and more than 75%, respectively. The average technical efficiency of the farms of Zone-III came out to be 61.88%.

The perusal of Table 7 shows distribution of sampled farms according to the level of technical efficiency in dairy farming in different zones of Punjab. It can be seen from the table that in case of Zone I the average technical efficiency of top 10% farms was 78.44%, it was 70.22, 64.86, 60.43 and 55.68% for top 20, 30, 40 and 50% farms,

Table 7: Distribution of selected farms according to the level of technical efficiency in dairy farming in Punjab.

Percent of Farmers	Technical Efficiency (%)		
	Zone-I	Zone-II	Zone-III
Top 10	78.44	94.28	84.68
Top 20	70.22	89.25	80.32
Top 30	64.86	84.68	75.44
Top 40	60.43	81.15	69.98
Top 50	55.68	78.44	65.18

respectively. The corresponding figures for Zone II and III were 94.28, 89.25, 84.68, 81.15 and 78.44% and 84.68, 80.32, 75.44, 69.98 and 65.18%, respectively. From all this we can conclude that similar to crop production farms of Zone II were most efficient in dairy farming due to better and easy excess to research and extension agencies, followed by farms of Zone III and Zone I.

Conclusions

The zone-wise analysis revealed that the farmers of Central-plain Zone were most efficient followed by South Western Zone and Sub-mountainous Zone. Results revealed that farmers of South Western Zone were making overuse of fertilizers and insecticides-pesticides. While, farmers of Sub-mountainous Zone were making under use of these chemicals. So, it can be concluded that even in the agriculturally advanced state Punjab farmers are not using the inputs efficiently. Thus there is a need to improve the technical efficiency of majority of the farms by reorganizing the use of inputs.

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Most of the important things in the world have been achieved by people who have kept on trying when there seemed to be no hope at all.

—Dale Carnegie

Feature

Impact of Tourism Industry: Indication from Assam

S. BORAH, N. BORTHAKUR AND C. HAZARIKA

Tourism is the fastest growing industry in Assam. There are lots of tourist resources available in the state, which may attract the tourists from different parts of the country and abroad. Tourism in Assam is essentially nature based, natural parks and sanctuaries, rivers, lakes warm water springs, forests, wildlife are the principal component of tourist attraction. The major trust area of the tourism potential in Assam is the forest and wildlife. The two world's heritages sites, including Kaziranga National Park and Manas National Park and many other sanctuaries and wildlife resources are the key parts of nature tourism or wildlife tourism in the state. Tourism has generated employment in different parts of the country, besides creating opportunities for tourist guides, conducted tours establishment of hotels, and so many other avenues in tertiary sectors, tourism can be a major source of employment in Assam. Information regarding the no. of Foreign Tourist Arrivals (FTA) in India during 2007 was 5.08 million as compared to 4.45 million in 2006 and 3.92 million in 2005. During the year 2007, India witnessed a growth of 14.3% over 2006 in FTAs. However, Assam does not present a happy picture. It was observed that percentage change of Indian tourist inflow to Assam was found to be highest in the year 1997 (157.48) while foreign tourist inflow to Assam was highest in the year 1996 (128.54). Despite the fact that Assam has the potentiality of developing tourism in a big way.

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Tourism is a complex industry, which deals with the physical, psychological and spiritual demands of people. The status of the tourism industry depends mainly on the type of facilities and services offered to tourists and the nature of tourist item, which may attract the visitors to particular areas. Natural, socio-cultural and manmade objects in an area constitute the totality of its tourist resources.

In summary, most of tourist attractiveness of a particular region may be influenced by natural factor, social factor, historical factor recreational and including shopping opportunities and accommodation and accessibility above those of minimal tourist quality.

Assam, one of the constituent states of the region, an embodiment of the natural beauty and grace, a true representative of region, has been at the centre stage of tourist attraction. The major trust area of the tourism potential in Assam is the forest and wildlife. The two worlds Heritage Sites including Kaziranga National Park and Manas National Park and many other sanctuaries and wildlife resources are the key parts of nature tourism or wildlife tourism in the state. Tourism has generated employment in different parts of the country, besides creating opportunities for tourist guides, conducted tours establishment of hotels, and so many other avenues in tertiary sectors, tourism can be a major source of employment in Assam. It is argued that every domestic tourist can generate direct and indirect employment of three persons and this can be higher in the case of inflow of very foreign tourist. It is also projected that every one million rupees invested in tourism 47.9 direct jobs can be created, besides, of course, creating more avenues for indirect employment. In the context of this, the present study aim to focus on the contribution/impact of tourism to Assam Economy and problems of tourism industry and develop strategy for its improvement.

Methodology

Time series secondary data on tourist inflow, revenue earned from tourist, number of Indian and foreign tourist to Assam were collected from various issues of "Tourist Statistics" published by Directorate of Tourism Assam, Indian Tourism Statistics 2007 and Reserve Bank of India and ATDC Guwahati. Percentage change of various aspects of tourism industry was calculated based on the previous year data.

Result and Discussion

Inflow of foreign tourists in India has recognized a 6% growth in 2000–01. The absolute figure is 2.7 million people from abroad. Foreign tourists fetched $3 billion to the Union exchequer making tourism the 2nd highest net foreign exchange earner in the country. Information regarding the no. of Foreign Tourist Arrivals (FTA) in India during 2007 was 5.08 million as compared to 4.45 million in 2006 and 3.92 million in 2005. During the year 2007, India witnessed a growth of 14.3% over 2006 in FTAs; the average annual growth in FTAs in India registered during last five years i.e. 2003 to 2007 has been more than 16%. The Table 1 gives the no. of FTAs in India in the year 1995 to 2007 and the percentage change over previous year.

Table 1: Foreign Tourist Arrivals in India (1995–2007)

Year	FTAs in India	Annual growth (%)
1995	2123683	12.6
1996	2287860	7.7
1997	2374094	3.8
1998	2358629	–0.7
1999	2481928	5.2
2000	2649378	6.7
2001	2537282	–4.2
2002	2384364	–6.0
2003	2726214	14.3
2004	3457477	26.8
2005	3918610	13.3
2006	4447167	13.5
2007	5081504	14.3

Source: Indian Tourism Statistics (2007)

However, Assam does not present a happy picture. Table 2 presents the inflow of both domestic and foreign tourist to Assam. It was observed from the Table that percentage change of Indian tourist inflow to Assam was found to be highest in the year 1997 (157.48) while foreign tourist inflow to Assam was highest in the year 1996 (128.54).

Table 2: Tourist inflow in Assam (1995–2006)

Year	Indian	% Change	Foreign	%Change
1995	3,48,532	–	2,575	–
1996	3,27,260	–6.1	5,885	128.54
1997	8,42,656	157.48	4,194	–28.73
1998	9,39,721	11.51	3,843	–8.36
1999	9,64,939	2.68	5,218	35.75
2000	10,01,577	3.8	5,959	14.2
2001	10,10,651	0.9	6,171	3.56
2002	19,53,915	93.33	6,409	3.86
2003	18,97,715	–2.87	5,419	–15.45
2004	17,53,925	–7.57	5,173	–4.54
2005	24,67,652	40.69	10,782	108.42
2006	32,68,657	32.46	11,151	3.42

Source: Directorate of Tourism Assam

The revenue earned for four financial year of Assam is tabulated in Table 3. It is evident from the table that there has been some increase in tourist traffic as also in the revenue earning from tourism deposit the fact the law and order situated in the state has not been satisfactory and insurgency activities are rife. The vol. of tourist traffic

Table 3: Revenue Earned from Tourist in Assam (Rs. '000)

Year	Directorate of Tourism	ATDC	Total
1996–97	3,688	NA	3,688
1997–98	2,743	1,972	4,715
1998–99	3,105	1,979	5,084
1999–2000	3,172	3,226	6,398

Source: Directorate of Tourism Assam

Table 4: No. of Indian and Foreign Tourist to Assam and Revenue earning from the Tourists

Year	Tourist staying in tourist lodges of the directorate		Tourist staying in other accommodation like hotel etc.		Total revenue earned from tourist lodges only (Rs. in lakh)
	Indian	Foreign	Indian	Foreign	
2000–01	14015	486	961954	6920	35.87
2001–02	15373	456	1675299	4755	38.89
2002–03	18427	520	1222135	5466	41.03
2003–04	19894	508	2010213	6337	60.44
2004–05	20820	804	2165230	8561	69.01
2005–06	24280	755	2562148	7554	87.11

Source: Directorate of Tourism Assam

and magnitude of revenue earning by the state over the last three years are shown in Table 4. It was observed from the table that tourist arrival and revenue earnings from the tourist were increasing over the years.

Assam Tourism: IT's Potential for investment: Schemes/infrastructure, projects sanctioned by the Government

Over the years, both the central and state Govt. of Assam has identified and executed about 80 medium and minor tourism projects with total financial outlay of Rs. 34.30 crore for infrastructure building as well as schemes for marketing and promotion of Assam Tourism. These included infrastructure projects like:

- Tourism complex
- Yatrinivas
- Tourist reception centre
- Up gradation and expansion of tourist facilities
- Development of pilgrim centres
- Water sports

Table 5: Ongoing Projects

Name of the projects	Approved cost (Rs. lakh)
1. Computerization of services	40.00
2. Development/beautification of river front along Brahmaputra Guwahati (ph.II)	100.00
3. Sound and light show at Talatal ghar, Sibsagar	55.38
4. SEL show at Srimanta Sankardeva Kalashetra, Guwahati	80.00
5. Development of Dighalipukhuri with provision for craft village	89.90
6. Construction of tourist lodge at Tinsukia	100.00
7. Construction of craft village at Guwahati	185.00
8. Construction of facilities for Pilgrimage at Kamakhya Pilgrim centre by providing toilet	110.00
facilities semi permanent str for Ambubachi mela etc.	
9. Eco tourism resort at Bhalukpung	90.00
10. Eco tourism resort at Manas	90.00
11. Central financial assistance the luxury cruise vessels for plying between Kaziranga and Guwahati Assam	140.00

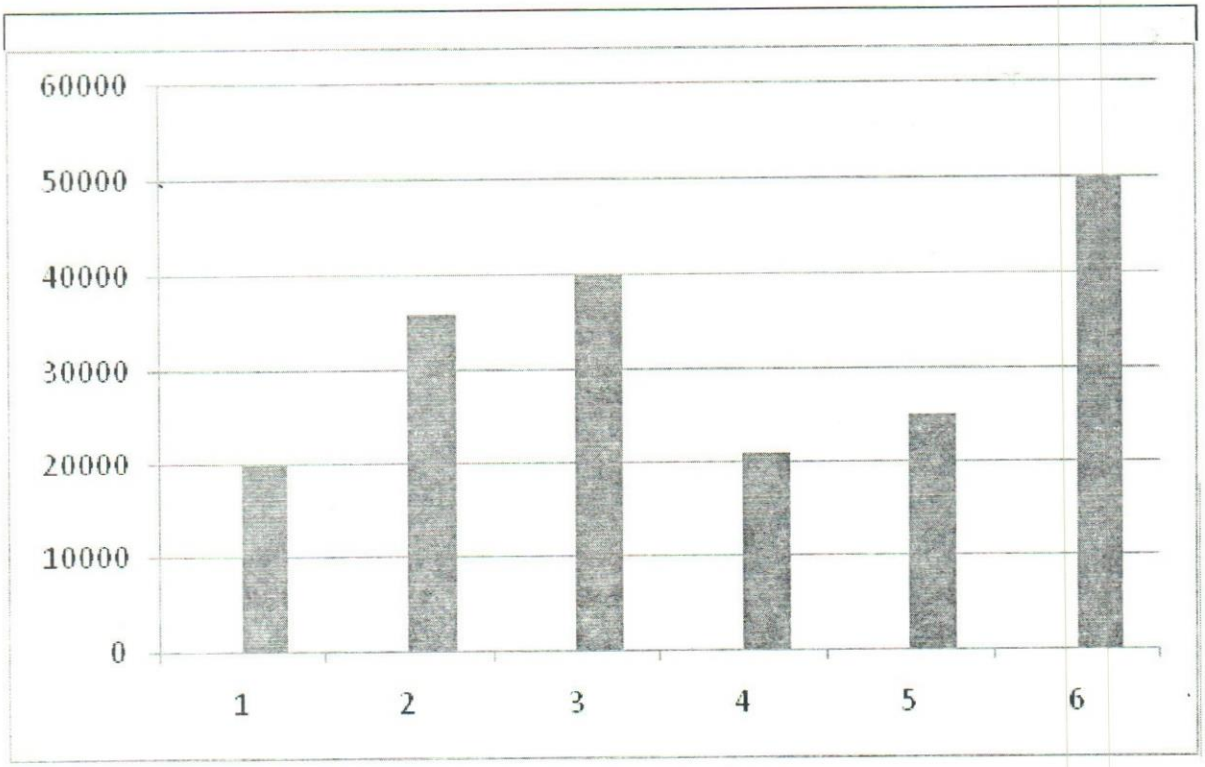

Fig. 1: Turn over per employee from 1994-95 to 1999-2000

Source: ATDC, Guwahati

Public-Private Partnership: Tourism is one sector, which cannot grow to its true potential with Govt. effort alone. The state Govt. has endeavored to intensity private sector investment and with the objectives in view, at present 32 various projects/units are run by ATDC in association private participation.

Figure 1 present the ATDC's turn over per employee for the last six years. It indicates that the ATDC is not a liability and has the potentiality of contributing to the economy of the state.

Table 6: ATDC's net profit (1994–95 to 1999–2000)

Financial Year	Net profit in Rs.	% Change
1994–95	7,00,000	–
1995–96	4,00,000	–42.86
1996–97	11,00,000	175
1997–98	3,00,000	–72.73
1998–99	11,00,000	266.67
1999–2000	20,00,000	–81.81

Source: AETDC, Guwahati

Problem faced by the tourism Industry in Assam

Despite the fact that Assam has the potentiality of developing tourism in a big way. The statistics shown in the tables do not present a happy situation. The reasons are manifold.

Absence of a tourism policy

The government of India has a policy to developed tourism in to an industry and target to achieve in respect of attracting foreign tourists.

Restricted area permits (RAP)

The KRAP to the N-E region was enforced in 1955 in the backdrop of alleged missionary involvement in the Naga rebellion. Under this a foreigner intending to visit N-E including Assam has to undergo a long arduous procedure of obtaining permission from home ministry.

Insurgency

Assam, and for that matter almost whole of NE, has been experiencing violent movements, some of which are secessionists in nature, since 1953 when AZ Phizo fired the first salvo of around struggle against Indian Union.

Lack of Infrastructure

To attract tourist, there must be dissemination of information, infrastructure facilities like good hotels and tourist lodges, affordable and reliable communication network, clean and hygienic food and accommodation, availability of water sports equipment and the like.

Lack of coordinated effort

There is a lack of coordination among several agencies like Department of Tourism and Department of Archeology in handling the demands of the tourists in places of both historic and religious importance.

Absence of Tourist Guides

Assam virtually does not have nay trained guides placed in important places of tourist attraction. Consequently, as the tourist arrives at such a place there is hardly anyone to satisfy the inquisitiveness of the tourists.

Development strategy on Tourism

The growth of tourism cannot be attained unless the issues related to all the related sectors are addressed simultaneously. During the 10th five year plan, a doubled pronged strategy of upgrading the tourism infrastructure and vigorous marketing under the banner of "Incredible India" campaign was followed to position India as a global brand. The 11th plan strategy on tourism is to achieve International tourist arrivals of 10 million by the end of the 11th plan through diversification of source markets, increase per capita spending and length of stay of international visitors and by reducing seasonality. The plan also proposed to achieve a level of 760 million domestic tourists by 2011 at an annual growth rate of 12% and to increase accommodation units. A multi-front strategy has to be developed to elevate tourism to the status of industry.

Summary of plan funds required for different schemes for 11th five year plan:

Name of scheme	11th plan outlay (Rs. in crore)
1 I. Centrally sponsored schemeProduct/infrastructure development for destination and credit	2500.00
II. Central sectoral schemes(a) Externally aided projects(b) UNDP Endogenous projects	30.00 10.00
2. Assistance to IHMs/FCI/IITTM/NIWS	300.00
3. Capacity building for service providers	90.00
4. Overseas promotion and publicity	1000.00
5. Domestic Promotion and publicity including Hospitality	400.00
6. Incentive to accommodation infrastructure	100.00
7. Contraction of building from IISM at Gulmarg, Kashmir	10.00
8. Market research including 20 yrs perspective plan	40.00
9. Assistance for large revenue generation projects	200.00
10. Creation of land band for Hotels	50.00
11. Equity contribution to ITDC	73.00
12. Assistance to central agencies for Tourism infrastructure development	200.00
13. Computerization and information technology	100.00
Total (C.S. Scheme)	2603.00
Grand total (C.S. and CSS)	5103.00

Conclusion

Tourism's importance, as an instrument for economic development and employment generation, particularly in remote and backward areas has been well recognized the world over. It is the largest service industry globally in terms of gross revenue as well as foreign exchange earning.

Tourism has the potential to stimulate other economic sectors through its backward and forward linkages and cross-sectoral synergies with sector like agriculture, horticulture, poultry, handicraft, transport, and construction etc. The consumption demand, emanating from tourist expenditure, also induces more employment and generates a multiplier effect on economy. As a result, additional income and employment are generated through such linkage. Thus the expansion of the tourism sector leads to large-scale employment generation and poverty alleviation. The economic benefits that flow into the economy through growth of tourism in the shape of increased national and state revenues, business receipts, employment, wages, and salary, buoyancy in central state and local tax receipt can contribute towards overall socio-economic improvement and accelerated growth in economy.

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I will not follow where the path may lead, but I will go where there is no path, and I will leave a trail.

—Muriel Strade

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