Rural Non-Farm Technological Change: Analysis of Effects and Implications for Rural Linkages in Southeastern Nigeria

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Abstract

Technological change has affected most of rural non-farm enterprises with many positive and negative social and economic consequences. This study investigated the extent of this change and the linkage implications of the change on the rural economy of southeastern Nigeria. It also attempted assessing technical change in relation to the perceived negative consequences, to find out if the change was neutral and/or biased to those consequences. A total of 200 non-farm entrepreneurs randomly selected from 10 rural communities in 5 out of 9 states of southeastern Nigeria provided the quantitative data. Quantitative data and qualitative data were collected using interview schedules and focus group discussion (FGD) guide respectively. Analysis of quantitative data was by the use of descriptive statistics, cross tabulations, and factor analysis. Analysis of qualitative data was by folk interpretation and verbatim quoting of discussants views. Analysis showed that some personal socio-economic attributes of the rural entrepreneurs affected their technological adoption and use behavior, which were regarded as negative consequences rather than wrong use of technology. Varimax rotated factor matrix of non-farm variables were used to identify and name factors that need urgent technology policy intervention. These include cost of new technology, wrong adoption of technology, non awareness of new technological packages, perception of traditional technology as superior to improved technology among others. Some of the effects of technological change were adjudged neutral while some were taken as biased to the problems of the rural enterprises. Three types of rural linkages identified in the area were: consumption, backward and forward production linkages, and their implications on technological change and the rural economy were highlighted.

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Keywords: Biased, Neutral, Non-farm, Technological change, South-Eastern Nigeria .

Introduction

In Nigeria, and indeed most developing countries of Africa, rural non-farm entrepreneurs are struggling with a problem which seems to be aggravated rather than alleviated by technological change. Technology whether modern or traditional is knowledge related to production, products, processes, repair and maintenance (Khalil, 2002). Technology, from the point of view of some economists are all those methods of production which have been developed or could be developed with the existing state of scientific knowledge. Bell (1984) views technology from three levels: first, technology as embodied in the capital goods, engineering and managerial services, product and process, and capacity to create new production facilities. Second, it includes knowledge and skills related to operation, maintenance and repair of production facilities. Third, it consists of knowledge, skills, experience used in generating and managing technical change. This last category is distinguished from the previous two in that it focuses on either incremental or radical innovations or both.

Technological change from the foregoing would refer only to advances in scientific knowledge from which new production methods can be derived (Ellis, 1988). Thus according to Ellis (1988), technical change is never just about the advent of new, more productive method of production taken in the abstract from the social conditions of survival of entrepreneur families. It is always also about the survival conditions themselves. It involves far reaching strategic questions about the nature of new technology, its adoption and diffusion between different kinds of non-farm enterprises and its social as well as its economic attributes.

Rural technologies are seen as those developed or evolved in our traditional areas or villages and have in most cases been transmitted un-modified or slightly modified through a particular lineage in the traditional setting (Ikeme and Uvere, 1995). These community technologies provided household goods and agricultural inputs to the community, served as repair men and sold some goods and commodities to urban areas. Some non-farm technologies could be indigenous, meaning that they are technologies which involve the exploitation of our indigenous human and material resources to suit our environment, social and economic needs (Umeh, 1982).

It is clear that any change in non-farm technology must have positive and/or negative social and economic consequences and implications on the rural enterprises and the entrepreneurs. The negative effect may be related to poor adaptability and non-sustainability of the new technology which may be due to defective mode of adoption. The positive effects may be in form of labor saving, higher productivity of factors of production leading to increased income, and reduction in environmental degradation. Any change in traditional non-farm technologies must of necessity recognize the need for a concomitant change in the farm which must have sustainability as the basis. This is because rural linkage is just about the interaction of the rural farm and non-farm activities that may lead to rural economic growth. Hence, Meir (1984) is of the opinion that appropriate technology (technology with positive effects) is one which the resources/use requirement is locally available, and which meets the needs of people on sustainable basis. In other words, appropriate technology for the rural sector is one that upgrades and improves traditional technologies without a significant deleterious socio-economic effects on the entrepreneurs and end users (Meir, 1984; Massaquoi, 1993).

Just as modern textile replace hand-woven ones, and synthetic replace cotton, metal and plastics have come to replace earthen pots and wares. This process is intensified by the spread of capital intensive industries and urban based industries that threaten a wide range of traditional cottage industries and artisanal activities that have long provided income for rural entrepreneurs. Such rural cottage industries include hand weaving, rice pounding, garri processing, palm oil processing, pottery, blacksmithing, local gin distillery among others.

It is worthy of note that some of these traditional craft and technology industries provided most of the needs of the Igbo tribe of southeastern Nigeria during the civil war in Nigeria (1967 – 1970). That was when the people of the region were blocked out from trading with other African countries and the world. This suggests that a people can exist and be sustained by their own traditional craft, science and technology.

No country or government can stop the dynamic modern technology from overtaking the less profitable one. Also the argument is not that modern technology does not have positive consequences even on the traditional enterprises. But the argument especially for developing countries is that the technological change should not be destabilizing to people involved in enterprises that use the traditional technology, especially rural women. Rather, a system must be developed which aims at integrating the new technology with the old, thereby making the people to still be relevant and competitive within the changing environment. It is only through this way that the much needed rural linkages that could engender sustainable rural development and growth could be achieved.

The specific problem of this research therefore is that the effects of technological change on traditional non-farm enterprises and its implications on rural linkages especially in southeastern Nigeria seem not to sufficiently established and understood. Yet this knowledge could be useful for improved technological policy capable of engendering effective rural linkages and sustainable rural development. The questions remains: is there no way of understudying the rural enterprises in order to find out their prospects and problems as they relate to technological change? What are the levels and forms of the positive and/or negative effects of change in technology on the rural non-farm enterprises and entrepreneurs? What are the implications of this change effects on rural farm and non-farm linkages?

The specific objectives of this study are to:
(i) assess the magnitude of technological change on rural non-farm enterprises and the perception of the entrepreneurs over the change;
(ii) assess the effects of technological change on rural non-farm enterprises and the linkage implications on the rural economy.

Neo-classical economists often like to think of technological change as being "neutral" meaning that technological change itself cannot be blamed for altering the combination of labor and capital used in production (which can only be altered if their relative prices change). If technical change as "biased" in favor of using more of one resource than another, then different social as well as economic implications follow from technological change. For example, labor-saving technological change which is biased implies a lower share of total income accruing to non-labor resources. When purchased inputs and fixed capital goods are imported this means in addition higher payments to foreign factors of production and lower payments to domestic factors of production (Binswanger and Ruttan, 1978, Kisler and Peterson, 1981).

This study will analyze the identified consequences of technological change as either "neutral" and/or "biased" and derive the implications on rural linkages.

Methodology
The study was carried out in four out of the nine states of southeastern Nigeria. The states are Abia, Akwa-Ibom, Ebonyi and Enugu. Some of the indigenous non-farm enterprises common in the rural areas and undertaken by men include wine tapping, blacksmithing and metal working, wood carving and local gin distillery, while women are involved in food processing, cloth weaving and dyeing, pottery and local beer brewing.

A multi-stage sampling technique was employed to sample first the states and then the local government areas (LGAs) within the states. The choice of the states and LGAs and communities within the LGAs was purposive, based on popularity in a particular non-farm activity. In all, four LGAs were chosen from the four states out of which eight communities were selected for the study. From a compiled list of entrepreneurs, fifty rural non-farm entrepreneurs were chosen from each community using the simple random sampling technique. In all, 200 rural entrepreneurs supplied the data. A rural non-farm entrepreneur selected for the purpose of this study was one that devoted up to 60% or more of his/her working time or available labor to the enterprise.

A reconnaissance survey was carried out in order to give the researchers an overview of the nature of the rural communities and enterprises, after which a final survey was conducted to collect primary data using structured interview schedules. Trained enumerators from each community assisted in the collection of the cross-section data which lasted for a period of 12 months.

The nature of data collected related to the socioeconomic attributes of the non-farm entrepreneurs and other variables associated with adoption of changed technologies. Issues relating to the adoption of non-farm innovations were arranged on a five-point likert-type scale, for entrepreneurs to indicate their level of agreement with each issue perceived to be positive and/or negative effects of adoption and diffusion of non-farm innovations in the community.

Data Analysis

Preliminary analysis of data involved the use of descriptive statistics and cross-tabulations with X^2 output.

Since many factors relate to issues of adoption of technological change and consequences of adoption on the rural enterprises all of which are theoretical, it was necessary to examine the issues using factor analysis. Factor analysis is a method for exploring the structure of the data. The aim of the method is to account for the co-variances of observed or manifest variables known as factors. This is where the factors are unobservable variables or theoretical concepts.

Taking n as observations on each of the variables x_1, x_2, x_3 …, x_p; and we suppose that m is the underlying factors F_1, F_2, …, F_m, where $M < P$; then the factor analysis model assumes that each xj (j = 1, 2, …, p) can be written as a linear combination of the factors and a residual variable. In effect, for each xj, we have a multiple linear regression model where xj takes the role of dependent variables and F_1, F_2, …, F_m, are like explanatory variables. For example, in terms of observations, if xij is the observation on variable xj, for the ith sample member then,

$xij = \lambda i1Fi1 + \lambda j2Fj2 …, \lambda jmFik + eij$

  (i = 1, 2, …, n, j = 1, 2, …, p).

where

  Fik = the score on factor Fk (k = 1, 2, …, m)

and eij = the value on the residual variable

  Ej for the ith sample member.

  F_1, F_2, …, F_m are known as common factors (since every xij is written in terms of all of them) and Ej is known as a specific factor since it corresponds to xj. All of the Fik and eij are unobservable. The weight λij, …, λjm are usually called the factor loadings (Jollife, 1986).

The assumptions to be made here about the model, in order to estimate it are; that the common factors, F_1, F_2, …, F_m are independent of one another, and the specific factor Ej, E_2, … E_p are independent of one another and of the common factors. The suitable number of factors were selected subjectively and the factors produced were rotated with the hope of finding a readily interpretable sets of factors.

Results and Discussion
Analysis of the social and economic attributes of the rural non-farm entrepreneurs who adopted some levels of innovation in their enterprises is given. Of the 200 entrepreneurs studied, about 60% of them were aged above 45 years. About 52% did not complete their primary education, while about 14% had secondary education and above. Up to 56% of them had family size range of 8 – 12 persons, while about 61% of them combined farming with their non-farm activities, and 39% were employed in the rural non-farm enterprises full-time. Up to 81% of the entrepreneurs earned less than ₦10,000 per month from their rural enterprises average number of workers employed in rural enterprises including apprentices was 3 persons; most of whom were family members.

Table 1 shows the type of rural enterprises studied and the level of adoption of innovation into production processes. Table 2 shows the cross tabulation of entrepreneurs according to levels of adoption and their perception of non-farm technologies available to them.

From Table 1, the levels of adoption of different types of non-farm technologies exposed to rural non-farm entrepreneurs show that, in cloth weaving, for example, about 35% of the entrepreneurs (mainly women) had adopted the use of modern l00m for weaving. The most adopted of the innovations exposed to the rural entrepreneurs was the garri processing machine, which up to 82% of those in the enterprise have accepted. Conversely, only about 4.8% of who tapped palm wine used modern containers and preservatives as technologies for storing and preserving palm wine.

A cross-tabulation analysis of adoption levels by adopters assessment of innovation, (table 2) shows that about 30.3% of the non-farm entrepreneurs who adopted at various levels agreed that the innovations as adopted are very good to their enterprises. About 31% indicated that such innovations though good for their enterprises in some aspect, had some adverse effects on their non-farm businesses. However, up to 38% of the entrepreneurs complained that adoption of such innovations have affected their non-farm enterprises adversely. It is however noted that most of those who indicated that adoption of innovation affected their non-farm enterprises where those who adopted less than 50% of the technological package exposed to them. This goes to show that partial adoption of technological package may have adverse consequence on rural non-farm enterprises.

Results of Factor Analysis
The aim of factor analysis was to identify those factors that might continue to encourage or discourage the production activities of entrepreneurs in rural non-farm activities. These factors may or may not be associated with technological change. Since the purpose was to identify new factors, then the interpretation boils down to identify the variables that load high for each factor. The variables loading high were used in naming the extracted factors. According to Kaiser (1958), the rule of thumb is that variables with coefficient of 0.30 or more have high loading and may be used in naming a factor. The rule has been generally applied (Child 1978; Alimba, 1999).

The variables that loaded high for the naming of the factors considered positive in relation to new non-farm technology adoption by rural entrepreneurs are as presented in Table 3. The variables for naming factor 1 are V_04 – number of workers employed in the enterprise (0.477), Vo_7, household expenditure level (0.413), and Vo_1, level of income generated from enterprise (0.314). The factor was named "socioeconomic relationship" because the variable that loaded high relate to the socioeconomic issues of the entrepreneurs. Factor 2 was named "production output relationship" after considering the variables that loaded high, which are: Vo_2 – quantity of product (0.616), Vo_8 – household labor demand in enterprise (0.367) and Vo_3 – quality of product (0.309).

For factor 3, Vo_5, number of apprentices that joined (yearly) (0.497), Vo_6 – average cost of production (0.468), and Vo_{10} – external financial assistance (0.360) all loaded high. After due consideration, factor 3 was named "motivation relationship" because the variables relate to issues that could motivate entrepreneurs to continue in production. Variable 9, interest shown by children (0.594) was used to name factor 4 as "future of enterprise relationship." This is because as the children of the entrepreneurs shown interest in the non-farm enterprise, the implication may be that such enterprise will continue to survive. Therefore, the four factors that are considered positive to the adoption of non-farm technological change in Southeastern Nigeria, were "socioeconomic relationship," which accounted for 31.2% of the issues, "production output relationship" 26.1% of the issues, "motivation relationship" 18.4%, and "future of enterprise relationship" 21.6%. Cronbach Alpha analysis shows that the variables used in naming factors 1 and 3 really were a cluster of related items ($\alpha > 0.5$), while those of factors 2 and 4 were not very cohesive items ($\alpha < 0.5$).

In the area of "positive socioeconomic relationship," issues such as high employment rate into the non-farm enterprises arising from the adopted technologies, increased income level generated annually from enterprise and improved quality of life of households as a result of increased income and consumption are considered positive socioeconomic consequences resulting from adoption.
Specifically, the entrepreneurs identified high quality and quantity of products resulting from new technology, and reduced demand of enterprises on household labor in the enterprises as relating to the improved production system. The increased number of apprentices that joined the enterprises yearly, reduced production cost, and financial assistance which they sometimes got, were named as good motivation force for continued adoption of the new technology. The future of the local enterprise was seen to be brighter due to increase in interest shown by children of entrepreneurs in the new production process. Children of the entrepreneurs are likely to take the enterprise as occupation if they continue to perceive the change in technology as it affects the rural enterprise as positive. However, a woman cloth weaver from Akwete community, of Ukwa East Local Government Area, in an FGD interview remarked thus:

> "Though our young girls seem to like the weaving enterprise at their early ages, they quickly abandon the activity soon after completing their primary, secondary or higher education; for urban opportunities. It is not a question of change or no change in the method of production, but that of poor conditions of life (absence of social infrastructure) in this village that is against the young ones" (FGD Respondent, Abia State, 1999).

Three factors which tend to affect the adopters of new technology in their rural enterprises have been identified and named (Table 4). Factor 1 which is "Inappropriate technology" was named as such because they have variables loading high – Vo_4 – issue of repairs and maintenance of equipment (0.381), Vo_8 – high cost of new technology (.324), Vo_1 – complexity of new technology (0.308), and Vo_6 – technology extension issue (0.390). Factor 2 was named "social and marketing relationship" because of the variables that related to it that have high loadings. They are, Vo_2 – quality of product issue (0.373), Vo_4 – labor displacement (0.408), Vo_5 – problem of product marketing (0.661). Factor 3 had variables Vo_7 – environmental issues (0.710), and Vo_4 – labor displacement (0.491) loading high. Therefore, it was named "social and marketing relationship."

Issues to be addressed from factor 1 will relate to inappropriate technology. The rural entrepreneurs complained mainly that some of the technical innovations exposed to them were very complex. Others complained of problems of repairs and maintenance of some mechanical technology they adopted when broken down, and poor extension activities relating to new technology. Some entrepreneurs noted that some of the new technical innovations were of high cost, especially the spare parts and accessories. For the factor named "social and marketing relationship," some rural entrepreneurs perceived the quality of products from new technology inferior to the traditional methods (e.g. cloth from hand loom compared

with machine operated loom and some food processing enterprises, e.g. garri processed with traditional equipment and that from machine. Poor marketing outlets of products mass produced from new technology was also identified. Rural markets have limited capacity, while some of the products do not compete favorably in urban markets especially with foreign products. The factor named "environmental relationship" identified the effluent and noise that result from machine technology especially in food processing enterprises.

The three factors considered negative to the adoption of non-farm technological change in southeastern Nigeria were "inappropriate technology relationship" which accounted for 42.3% of the issues, "social and marketing relationship" accounted for 27.7% and "environmental relationship accounting for 30% of the issues. Further analysis of Cronbach Alpha shows that the variables used in naming factors 1 and 3 were a good cluster of related items ($\alpha > 0.5$), while that of factor 2, were not very cohesive items ($\alpha < 0.5$).

Assessment of Technological Change in Rural Enterprises

Based on the result of factor analysis, an assessment can be made as to whether new technologies as adopted by rural non-farm entrepreneurs in southeastern Nigeria are neutral and/or biased to the perceived negative effects (Table 5). It should be noted that a technical innovation is adjudged neutral, when the change cannot be blamed for the perceived negative effects from such change. Technical change is then taken to be biased to the negative effects if it can be blamed for such negative effects as perceived, such as favoring of one resource use than the other (Ellis, 1988).

Implications of Technological Change on Rural Linkages in Southeastern Nigeria

It is known that in the rural areas of any developing economy, two activities are performed – farm and non-farm. The level of interactions between these two rural sub-sectors determine to a large extent the size of the rural economy. Rural linkages therefore, are here used to describe the manifold interaction between farm and non-farm activities in the economy of the area studied. The question here seem to be – to what extent has technical change in rural non-farm enterprises helped to foster rural inter-sectoral linkages, capable of engendering rural economic growth and hence higher quality of life for the rural entrepreneur households.

The linkage types identified in the study area and the problems that tend to hinder their development and exploitation of their benefits are discussed.

1.   **Consumption Linkages** – This is where incomes generated by activities in one sector lead to demand for output of another sector. This may operate from farm to non-farm and conversely. Analysis of regression data shows that income that flowed from the farm significantly contributed in increasing the non-farm income. This increased income to the non-farm households has positive implication on household expenditure and consumption of both farm and non-farm products. However, it was estimated that about 70% of the rural consumption expenditure was on non-rural goods and services, indicating a high rural income leakage to the urban sector. This tends to reduce the potency of rural linkages and growth in the rural economy. For example, women in Abia State do not patronize the local Akwete hand woven textile as much as they do to the mass produced factory textile materials from Aba urban. This obviously contribute to weakening consumption linkages through such leakages of income from the rural areas.

2.   **Production Linkages** – This may be backward or forward. Backward production linkages which occur where productive activity in one sector requires input from another e.g. hoes and machetes and fertilizer for farming, was high in favor of urban industries. Only about 35% of farm inputs such as hoes and machetes made by the local industries are purchased by the rural farmers in the area. The

other 75% of farm inputs come from urban industries. This has an obvious retarding effects on backward production linkages between farm and rural non-farm as farm technologies change. It should be noted that our regression analysis shows that income that flowed from the farm to non-farm activities enhanced the non-farm income significantly. Rural linkage is weakened if the change in technology significantly displaces the traditional technology and techniques with the attendance labor displacement. For instance, many rural blacksmith enterprises have been adversely affected by the current tractorisation technology, hence displacing the labor of blacksmiths in relation to farm equipments production.

3.   **Forward Production Linkages** – which occur when production of a commodity provides supplies for productive activities in other sectors. In this study, it is found in terms of processed and semi-processed agricultural products such as palm oil, garri, palm-wine, and herbal drugs, must of which serve as inputs to other productive activities. These products are indigenous and technical innovations in the enterprises have been adopted with minimal adverse effects on the entrepreneurs. The products are unique and only serve as inputs to the modern urban industries, thereby attracting income to the rural economy while using less of urban purchased input. Technical innovations which enhance forward production linkages must be encouraged, much as they can be sustained by the rural entrepreneurs.

Concluding Remarks
There may be no prospect for sustained growth and poverty reduction without faster and deeper technical change in non-farm enterprises in terms of production, marketing, and processing techniques for rural goods and services. The consequences of technological change affect areas and nations differently depending on the method of adoption and adaptation, and the manipulation of other social and economic variables relating to technical change. Part of the Asian Tigers success stems from the development of appropriate rural non-farm technologies and the efficient and effective inter-sectoral linkages between farm and non-farm enterprises. While not asserting that non-farm technical change has not got negative socio-economic consequences (which have been identified by this research), it is neutral to most of the perceived negative consequences. Rather, most of the problems of the rural non-farm entrepreneurs are related to wrong adoption and use of innovations due mostly to the social attributes of the adopters.

It is recommended however, that technology researchers and developers should aim at resource-conserving and cost effective technologies with high marginal revenue productivity. Basic education, extensive training and skills building must be among the actions facilitated by government and non-government agencies since it has been shown that education enhances proper adoption of innovation, leading to high income from non-farm activities.

Also, to tackle the problem of faulty adoption of non-farm innovations, non-farm extension program should be established to aid rural non-farm entrepreneurs. We recommend a radical revision of the country's technological policy to recognize and favor indigenous technical and craft industries, with the main aim of upgrading them appropriately. To this end, village polytechnics which will exploit the indigenous technical knowledge should be established at local government levels. The private sector should be encouraged to finance non-farm activities and to develop appropriate technology in use in the area of study. Information on markets and market access and raw material and technological availability should be provided to the entrepreneurs by the states and local governments in this area. The issue of rural infrastructure such as electricity efficient portable water supply and access road linking urban markets must be provided by government for new technology to be meaningful to the rural entrepreneurs and for effective harassing of rural linkages. The farm and non-farm linkages identified should be exploited for enhanced rural economic growth of southeastern Nigeria.

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Table 1: Type of Non-farm Enterprises studied, innovations identified and level of adoption in Southeastern Nigeria

	Rural non-farm enterprises	Technology Change	Level of Adoption and the Use by Entrepreneurs	
			Frequency (n = 200)	Percentage
1	Cloth weaving	Modern looms for cloth weaving	48	35.4
2	Garri processing	Cassava grinding machines	41	82.0
3	Palm oil processing	Palm oil processing machines	22	52.3
4	Traditional medicine	Use of machine to extract and package traditional drugs	4	14.3
5	Clay works	Use of clay mixing and molding machine and modern kilm.	2	6.1
6	Palm-wine tapping	Use of chemicals and factory containers to preserve and store palm wine	1	4.8
7	Traditional informal credit facilities	Use of formal credit facilities	68	48.9
8	Local marketing of products	Use of modern marketing systems (e.g. cooperatives)	96	69.1

Percentages are for those who are engaged in a particular enterprise. Source: Field Data, 1999.

Table 2: Adoption Level by Adopters Assessment of Non-farm Technology

Adoption Level (%)	Assessment Criteria			
	Very good to non-farm business	Good but with some problem to non-farm business	Devastating effects on non-farm business	Total
10.00	4(7.5)	3(5.4)	2 (2.9)	9 (5.1)
20.00	13 (24.2)	7 (12.7)	10(14.9)	30(17.1)
30.00	16 (30.1)	9 (16.4)	7 (10.4)	32 (18.3)
40.00	10(18.8)	14(25.5)	21(31.3)	45(25.7)
50.00	3(5.7)	6(10.9)	8(11.9)	17(9.7)
60.00	3(5.7)	8(14.5)	5(7.5)	16(9.1)
70.00	2(3.8)	3(5.5)	3(4.5)	8(4.6)
80.00	1(1.2)	-	1(1.5)	2(1.1)
90.00	1(1.2)	3(5.5)	4(5.9)	8(4.6)
100.00	-	2(3.6)	4(5.9)	8(4.6)
	53(30.3)	55(31.4)	67(38.3)	175(100.00)

Figures in parenthesis are the row percentages   Source: Computed from Field Data, 1999.

Table 3: **Varimax Rotated Factor Matrix of Positive Effects of New Technology Adoption Variables (Non-Farm Entrepreneurs)**[a]

Positive Effect Variables	Factors			
	1. Socio-economic Relationship	2. Production Output Relationship	3. Motivation Relationship	4. Future of Enterprise Relationship
Vo_1 Level of income generated (yearly)	0.314	0.022	-0.155	0.002
Vo_2 Quality of product	0.125	0.309	-0.188	-0.552
Vo_3 Quantity of product	-0.246	0.616	0.068	0.040
Vo_4 Number of workers employed	0.477	-0.166	0.226	-0.196
Vo_5 Number of apprentices that joined (yearly)	0.043	-0.036	0.497	0.230
Vo_6 Cost of production	0.023	0.115	0.468	-0.099
Vo_7 Household expenditure level	0.413	-0.200	0.037	0.018
Vo_8 Household labor demand in enterprise	0.072	0.367	0.051	0.247
Vo_9 Interest shown by children	-0.035	0.100	-0.015	0.594
Vo_{10} External financial assistance	0.177	0.065	0.360	0.160
% of explained variation	31.2	26.1	18.4	21.6
Cronbach α	0.612	0.283	0.556	0.363

[a] Coefficients in table represent regression weights and correlation coefficients
Source: Computed from Field Data, 1999.

Table 4: Varimax Rotated Factor Matrix of Negative Effects Associated with New Technology Adoption Variables

Positive Effect Variables	Factors		
	1. Inappropriate Technology	2. Social and Marketing Relationship	3. Environment Relationship
Vo_1 Complexity of New Technology	0.308	0.307	-0.093
Vo_2 Quality of product issue	0.253	-0.373	-0.044
Vo_3 Issue of repairs and maintenance	0.381	0.033	-0.070
Vo_4 Labor displacement	0.143	0.408	0.491
Vo_5 Marketing of product problems	-0.114	0.661	-0.105
Vo_6 Technology extension issues	0.390	-0.054	-0.210
Vo_7 Issue of cost of new technology	0.324	-0.082	0.160
Vo_8 Environmental issues	-0.074	-0.190	0.710
% of explained variation	42.3	27.7	30.0
Cronbach α	0.521	0.421	0.624

Coefficients in the table represent regression weights and correlation coefficients.
Computed from Field data, 1999.

Table 5: Assessment of Technological Change in Rural Enterprises

Assessment Criteria/Effects	Description	Verdict (Neutral and/or Biased)
i. Difficult to adapt technology to production due to its complexity	Inappropriateness of technology to the problem of entrepreneurs	Technical change is biased
ii. Lower quality of products of technology	Inappropriateness of technology. Also wrong use of technology so adopted	Technical change is neutral/biased
iii. Difficulty in repair and maintenance	Unsustainable technical change	Technical change is biased
iv. Labor displacement leading to rural out migration	Displacement of labor may be due to their relative prices. Other social factors may cause out-migration	Technical change is neutral
v. Problem of marketing of product of new technology	Rural markets may be small, for the large products of new technology. Also, other social infrastructure that aid marketing may be lacking	Technical change is neutral
vi. Difficulty in awareness creation and adoption of innovation	Limitation is imposed by lack of extension activities on new technology; aimed at awareness creation and proper adoption	Technology change is neutral
vii. High cost of technical innovation	Rural entrepreneurs are mainly resource-poor; and lack access to credit. Attitude to cooperative to pull resources together to purchase new technology is lacking.	Technical change is neutral
viii. Increase in households economically headed by women	Technological change has occurred more in non-farm enterprises stereotyped to women; e.g. cloth weaving, agro-processing, etc. men are forced to migrate to the urban	Technical change is biased
ix. Reduction in households standard of living	Investment in technical innovation in rural enterprises usually do not give good returns due mainly to marketing problems, unfavorable competition with imported ones, hence, low income and expenditure to entrepreneurs households	Technical change is neutral/biased
x. Negative externalities	This may be in form of effluents, noise and other forms of environmental pollution especially from processing technologies	Technical change is biased.