Chapter II

Literature review

2.1 Factors influencing the adoption of rice production practices: conceptual perspectives

Why farmers' production practices vary from one place to another or from one farm household to another has been a mater of constant concern for extensionists, economists, researchers, policy makers and planners. Professionals from different areas have given several explanations based on the different circumstances and environments. Some of the explanations are very narrow, focused on a specific or few factors, while some are broader and considered an array of explanatory variables. Some explanations are relevant but less useful for devising strategies conductive to effective production practices, as they do not provide comprehensive explanation to the question raised at the beginning of this discussion.

Many researches found that multiple sources are required to 'prompt' change. Prior studies have related farmer's adoption behavior to various personal, physical, social, ecological, economic and institutional factors (Ervin and Ervin, 1982; Lapar *et al*., 1999; Milham, 1994; Norris and Batie, 1987; Pender and Kerr, 1998; Shiferaw and Holden, 1998).

2.1.1. Social factors explaining technology adoption

The schooling period of farm household heads is important social factor influencing the adoption of land management technologies. In the rural context, household heads are the ones who take decisions on the major matters, including land management. Farm household heads who have opportunity to study in formal educational institutions for a long period acquire more knowledge and strengthen their analytical capability (Paudel and Thapa, 2004). Besides, their capability to seek information and get necessary support from government and non-government organizations is also improved by the education. Better-educated farmers are aware of several kinds of land conservation measures through their good personal contacts with agencies involved in land management. Illiterate and low educated farmers cannot get such opportunities, which inhibit them from the adoption of conservation technologies. According to Sidibé (2005), there was a significant positive relationship between the level of education and adoption of soil conservation measures.

Education and training influence the adoption in three broad ways: first by delivering new knowledge and skills; second by providing interaction with experts (that is facilitators, trainers or teachers); and third, by providing opportunities for interaction with peers (that is, fellow training participants) (Kilpatrik, 2000). Education and training presents opportunities for interaction with other farmers and with facilitators as well as opportunities for receiving new information. This interaction assists in altering values and attitudes towards new practices.

Agricultural labor force size, household head's schooling period and farmers' participation in joint land management activities are social factors significantly influencing the adoption of land management technologies (Paudel and Thapa, 2004). Agricultural activities are highly labor intensive. Besides collection of fodder and fuel wood, farmers have to plough land twice or thrice depending on the crop, slice terrace risers, cultivate crops, take out weeds and harvest crops. The labor requirement is substantially increased, if farmers want to improve terraces, construct check dams and retention walls, and apply adequate amounts of green manure and compost to their farmlands. Therefore, there is a tendency to increased adoption of land management technologies with an increased number of household members engaged in agriculture. Despite their willingness, farmers with a relatively small agricultural labor force cannot take care of farmlands effectively. It is beyond their capability to meet the labor requirement for all kinds of conservation practices.

The influence of household size on the decision to adopt is not clear. If an agricultural technology increases the seasonal demand for labor, it would be less attractive to a household with limited family labor. Besides labor demand, the other factor related to family size, mentioned as a consideration in adoption decisions, is the consumption pressure the household faces, i.e. the responsibility of the head of the household to ensure that the minimum food requirement of the family is met. If the technology is a staple crop, the direction of effect on adoption in subsistence agriculture is ambiguous. While the higher consumption pressure a larger family faces may motivate adoption, the risk involved with a new and untried variety may inhibit the head of a larger household from adopting it. Considering the above factors, the impact of family size on intercropping is assumed to be positive, as there is no increased seasonal demand of labor in the recommended major crops such as banana and pineapple; however, this could be an ideal option for dealing with consumption pressure (Herath and Takeya, 2003).

Farmers' participation in joint land management activities, like check dams and retention walls construction, and gully stabilization, is also an influential social factor. The construction of conservation measures like check dams, retention walls and waterways requires substantial amounts of labor, financial and material resources, which is beyond the affordability of an individual farm household. However, farmers who organize themselves in social groups and pool their personal resources together for common benefit can manage to undertake such activities. Hence, there is a tendency towards increasing the adoption of land management technologies with increasing farmers' participation in joint social activities (Paudel and Thapa, 2004).

The age of a farmer is correlated with educational status. Younger farmers have relatively more formal education than older farmers. This is because the expansion of formal education into the rural area of Ethiopia is a recent phenomenon that started in the late 1970s. Age of a farmer, therefore, also serves as a proxy for the educational status of the farmer. Younger farmers have longer planning horizons and, hence, are likely to invest more in land conservation practices (Bekele and Drake, 2003).

The age of the household head was negatively associated with the probability of adoption. Younger farmers were more likely to adopt and the effect of age on the probability of adoption was elastic suggesting that policies, which impact demographics and migration patterns would also affect the probability of adoption. Macroeconomic events beginning in the late 1980s may have slowed rural–urban migration and increased the cohort of young farmers in the rural population (Gockowski and Ndoumbé, 2004).

Age was insignificant as a predictor of adoption, which is in contradiction to expectation. Age is usually associated with attitude towards risk, younger farmers are more likely to be risk takers and hence more likely to be adopters than older farmers. However, in this example much more is known concerning the technology and its associated risk is small. Thus, the affect of age on the adoption process is reduced. This inference is supported by statistical non-significance of a variable representing subjective risk assessment in the model. Education and tenancy were also insignificant (Sheikh *et al*, 2003).

According to Ayuk (1997) the age relationship to live hedge adoption is positive. It, therefore, suggests that if the individual's age increases by one year the probability of this farmer adopting the technology increases by 1%. A possible explanation for this is the facts that as farmers get older the requirements for the establishment of dead fences are overburdening. It can also be due to the fact that the probability of adoption may be an increasing function of time.

In a study by Somda *et al*., 2002, suggests that, the age of the farmer had a significant negative impact on adoption. Older farmers are less likely than younger ones to adopt compost. The latter are likely to be more knowledgeable about new practices and may be more willing to bear risks due to their longer planning horizons.

Family size has a significant negative correlation with the adoption of land conservation structure (Bekele and Drake, 2003). This might be due to the relation between larger family size and the corresponding higher demand for food in the household. In a family with a greater number of mouths to feed, competition arises for labor between food generating off-farm activities, like daily labor, and investment in land conservation. Under such conditions the satisfaction of immediate food needs is given higher priority and labor is diverted away from land conservation. Even during slack labor seasons, the opportunity cost of labor for households with more mouths to feed will be higher. Thangata and Alavalapati (2003), showed that an additional working member in a household increases the likelihood for agro forestry adoption.

Another study show that important assets like land holdings are not necessarily distributed in proportion to family size. Households with a larger family size will have a lower land-man ratio, which may mean that they have an incentive to invest in conservation for production intensification. On the other hand, the potential loss of land to conservation structures may discourage adoption as these households will not be in a position to assume the risk associated with the introduction of conservation structures (Lapar *et al*., 1999). This latter explanation seems to be most appropriate in this case, not least because similar results have been reported from the Central Highlands of Ethiopia (Shiferaw and Holden, 1998).

The results of Sidibé (2005) showed that the membership of social organizations is positive and significant for adoption of stone strips. The likelihood that a member in a farmers' organization will adopt stone strips is greater than for a non-member. This may be explained by the numerous advantages of belonging to an association. For instance, members have easy access to training, information, inputs, credit and borrowing agricultural equipment.

2.1.2. Economic factors explaining technology adoption

The landholding per economically active person of the family is found to have a very significant and negative correlation with recommended conservation structures It indicates that the preference of farmers with larger landholding per economically active person of the family to invest less or not to invest at all in conservation. This result does neither support the argument that larger land holding, as associated with greater wealth and increased availability of capital, makes investment in conservation more feasible nor that wealthier people are willing to bear more risk than poorer people (Bekele and Drake, 2003).

There is mixed evidence about the impact of land ownership and full time operation of a farm on incentives to adopt a new technology. On the one hand, land ownership is hypothesized to increase incentives by lengthening planning horizons and the share of benefits accruing to the adopters while lowering the rates of time preference. In this regard, full time operators are expected to be more likely to adopt a time and management intensive technology (Cooper and Keim, 1996). On the other hand, the potential for such technologies to conserve input use, reduce cost, and provide economic benefits even in the short run could create incentives for adoption even among renters and part-time operators as observed by Lee and Stewart (1983).

The negative effect of land availability indicates that increasing land constraints positively influence the adoption of commercial horticultural production systems. This suggests that, intensification of horticulture production should target areas of relatively high population pressure (Gockowski and Ndoumbé, 2004).

Those farmers with larger areas are more likely to be adopters than farmers with smaller areas. This variable is highly correlated with farm size and income, both of which could be substituted into the model in place of the combinable area. However, the models fit would be inferior and fitting all three variables together introduces the problem of high correlation between the independent variables. Thus this result that larger, wealthier farmers are more likely to adopt the new technology is as expected (Sheikh *et al*., 2003).

The dummy variable representing the ownership of land shows a significant negative impact on the intercropping. This indicates that when there is single ownership and the farmer is involved full or part-time in farming, the probability of intercropping likely to be lower compared to the base category, where rubber lands have been rented or the immature rubber lands have been leased for part-time operators for farming during the immature period (Herath and Takeya, 2003).

Off-farm income is negatively associated with the probability of adoption. The impact is significant. In terms of marginal impacts, an increase of around 10% in the number of farmers with off-farm income will lead to a decline in the probability of intercropping of about 1%. This may be due to a lack of resources such as labor for farming activities due to off-farm activities (Herath and Takeya, 2003).

Livestock is generally considered to be an asset that could be used either in the production process or be exchanged for cash or other productive assets. Livestock holding of a household had been affected the conservation decision positively. First of all livestock is considered as a measure of wealth and increased availability of capital which make investment in conservation more feasible (Norris and Batie, 1987). Secondly livestock, particularly oxen, are used as working assets to perform farm operations, which increases the possibility for timeliness effects. Farmers in the area own different types of livestock.

The credit for household food and small financial requirements was positively influence conservation decision (Bekele and Drake, 2003). If a farmer can get credit to solve small but crucial financial and food problems, he can use the labor force of the family, which would otherwise be used for off-farm income generating activities, to build conservation structures.

These results suggest that non-farm income is the crucial liquidity source for investment in animal traction, a relatively costly package for most farmers. In fact, non-farm income is the main source of cash income and is a substitute for formal and informal credit to finance such capital acquisition: formal credit mechanisms do not finance animal traction investments, nor does the cotton parastatal credit scheme (which is mainly used for the purchase of fertilizer), nor does informal credit (from moneylenders in the village) to any significant extent (Savadogo *et al.*, 1998). Non-farm income was found to be an important indirect determinant of farm productivity, and ability to intensify production, via its effect on technology adoption. This was, in particular, the case for the zone where agriculture commercialization is occurring. Non-farm income is the main source of cash income in the area, and credit is generally unavailable for animal traction equipment purchase. Hence, in the Guinean zone, non-farm income affects the household's capacity to buy the equipment, which is an expensive package.

The role of off-farm income on the decision to adopt is not very clear. It is observed that farmers with off-farm income are less risk-averse than farmers without sources of off-farm income. Off-farm activities will reduce the management resources available for the adoption process, but access to outside information may have positive effects. Given that most of rubber small holders depend on family labor for their farming, off-farm activities might have a negative impact on intercropping (Herath and Takeya, 2003).

The greater agricultural income of farmers, more likely is the probability of them to adopt compost technology. The increasing effect of compost on crop yield allows farmers to generate crop production surpluses for selling, which in turn increases the agricultural income. Having assessed this impact, farmers are able to evaluate the tradeoff between composting and other soil fertility technology. This is the basis of their comparative perception of the effect of compost with regards to other fertilizes (Somda *et al*., 2002).

2.1.3. Institutional factors explaining technology adoption

Farm businesses, which participate in training, are more likely to make changes in their practice, which are designed to improve profitability. Training makes impacts of farm businesses through awareness of greater number of possible innovations, via improved decision-making and allocation of resources and via attitude, which encourage in practice (Kilpatrik, 2000). Expert advisers, other farmers and training events were important at all stages of the decision-to-change process.

They were the major sources of awareness of subsequently implemented strategies and practices as well as major sources of influence on the decision to change. The opportunity for interaction with peers, family and friends facilitates changes in values, attitudes and beliefs. Indeed, interaction with such institutional and emotional connections may be necessary before change can occur. Interaction with peers also provides the opportunity for awareness of new practices.

Extension services provided to and training attended by farmers significantly influence the adoption of land management technologies. Extension workers had made farmers aware of the advantages of locationally suitable land use and management technologies, and persuaded them to adopt. Extension workers and training programs help to clarify whatever the suspicion or doubts farmers may have, and motivate them to adopt conservation technologies (Paudel, 2004). There is tendency to increasing the adoption of land management technologies with increasing extension service. According to Sidibé (2005), training was positively related to recommended soil conservation methods.

Contacts with extension agents and social participation are expected to have a positive effect on adoption based upon innovation diffusion theory. Such contacts, by exposing farmers to information, can be expected to stimulate adoption. Higher visitation rates by extension personnel reduce not only the likelihood of farmers choosing slash and burn agriculture, but also promote movement into multi- and mono-cropping (Herath and Takeya, 2003).

The farmer's degree of access to information from agricultural experts influenced conservation decision positively. Farmers who have frequent contacts with agricultural experts and easy access to information about problems, potentials and performances of agricultural technologies are more likely to adopt new technologies. Technical assistance for the initial construction of soil and water conservation structures is positively and significantly correlated with adoption of recommended types of structure (Bekele and Drake, 2003).

The farmers generally felt that the individual channels could provide useful information on farming. They preferred to have, specially, more farm visits from the extension worker. Farmers do expect the extension worker to visit their farmers regularly and offer them advise rather than their seeking advice from the extension worker (Sivayoganathan, 1979).

According to Thangata and Alavalapati (2003), extension contacts played a major role in promoting mixed intercropping technology. At the policy level, this implies that improving the quality of the extension system is of paramount importance in Malawi. In providing effective services, extension agents are expected to conduct frequent meetings with farmers within their jurisdiction. However, limited means of transportation prevent them from conducting frequent meetings with farmers.

The level of extension input had a large and consistent effect on adoption, with increased extension input leading to increased adoption due to its positive effect on ‘awareness’ and ‘trying’. Extension is therefore clearly important. This suggests that, to enhance adoption at the household level, investment of development resources must be balanced between research and extension (Floyd *et al*, 2003). Increased levels of extension input were associated with increased levels of technology awareness, with increased rates of trying once aware and with a lesser frequency of information and/or inputs related constraints. Adoption rates were significantly lower amongst resource-poor households (characterized by food self-sufficiency level) and amongst the occupational castes but there were no consistent significant differences in adoption related to gender or access.

Most farmers in the study area learned System of Rice Intensification (SRI) from non-governmental extension agents. There was a large increase in non-adoption for three of the sites corresponding to the temporary disruption of extension services in 1999. This suggests that extension support is critical for this technology well beyond the period of initial introduction. Put differently, one might expect new adoption to fall off in the absence of extension training, but the decline in SRI use by established users is a bit more puzzling (Moser and Barrett, 2003). In addition to the issues of the equitable diffusion of SRI, this study also raises questions concerning the costs of diffusion. The apparent reliance on extension and high rates of disadoption in the absence of extension suggest that it may take farmers several years to become comfortable practicing the method without assistance. Moreover, if the effect of extension is less than of conforming to authority figures' expectations, a permanent extension presence would be needed. If technical support needs to be available at village level for extended periods, the costs of diffusing the method in Madagascar on a large scale would be quite high. It is found that the importance of seasonal liquidity and labor constraints in influencing adoption patterns among poorer farmers. Furthermore, the widespread adoption of off-season cropping requiring significant purchased external inputs, relative to that of SRI, an almost ideal low-external-input practice, demonstrates that the appropriateness of a technology for smallholder farmers is not necessarily defined by the type of inputs required. The opportunity cost of the scarce resources farmers must invest in adoption of new technologies or assets largely determines the attractiveness of these options. Sometimes the scarcity of cash makes labor, the only means by which the poor can earn cash, the scarcest input of all.

Distance from the farm dwelling influences conservation decision negatively. The family size of the farm household affected conservation decision positively (Paudel, 2004). Larger family size is generally associated with a greater labor force available to the household for timely operation of farm activities including conservation. More labor hours will be spent on conservation activities during labor slack seasons because of the low opportunity cost of labor in rural areas (Paudel, 2004).

The cash requirements for intensive horticulture production combined with the failure of formal rural credit institutions present a constraint to adoption especially for resource-poor households. This suggests that past policies in Cameroon supporting smallholder tree crop production had a positive impact on the adoption of intensified commercial horticulture production, although the effect is relatively inelastic (Gockowski and Ndoumbé, 2004).

Rural road infrastructure and communications had significant and elastic effect on the probability of intensive horticulture production. Elasticity at the sample mean which underscores the importance of public investments in rural transportation infrastructure in the process of agricultural intensification. Marketing costs also have a significant and elastic effect on the adoption of intensive horticulture systems (Gockowski and Ndoumbé, 2004).

The farmers felt that radio can serve as a useful communication channel and it is convenient and dependable. Although it may not be possible, via the radio, to localize messages for specific groups of farmers at different locations, it could be more effectively utilized to disseminate agricultural information applicable to wider farm audience (Sivayoganathan, 1979).

2.2 Synthesis of literature of review

Different models have been suggested to explain the decision to adopt new technologies (Tolman, 1967; Rogers, 1995). Morris and Adelman (1988) have argued that there is no single theory of causation that can embrace all aspects of adoption and explain the traditional attitude of small farmers towards technologies in developing countries. According to Tolman (1967), the adoption behavior of an individual is a function of socioeconomic and environmental factors and the adoption is endogenous to the sum of the interacting forces of his/her situation. Following Tolman (1967), Düvel (1994) adds that adoption behavior is a mental process governed by a set of intervening variables: individual needs, knowledge about the technology, and individual perceptions about methods used in meeting those needs in a specific environment. Nonetheless, these intervening variables are shown to depend on a set of socioeconomic variables.

Lindner and Pardey (1979) noted that many of the past temporal and spatial diffusion models put forward by economists were based on a general assumption that the potential adopter is a passive participant in the adoption process. Spatial diffusion studies have shown two strands of thought. One strand is concerned with the neighborhood effect and resistance, while the other strand focuses on the role of technology suppliers and innovators. In general, spatial and temporal models have been concerned with the spread of knowledge about the innovation, not the rate of adoption of the innovation itself. This means they have ignored the central determinant of the rate and pattern of adoption which is the decision process involved in moving from a state of awareness to actual adoption.

According to Rogers (1995), adoption can be defined as a decision to make full use of an innovation as the best course of action, and rejection or non-adoption as a decision not to adopt an innovation. The innovation–decision process is the process whereby an individual or any other decision-making unit passes through five stages: knowledge of an innovation, attitude towards the innovation, decision to adopt or to reject, implementation, and finally the confirmation of the decision.

Somda *et al*. (2002) suggests that a given agricultural technology embodies a number of important characteristics that may influence adoption decisions. In addition, given characteristics of technology, other socio-economic and demographic characteristics of the farm household may influence technology adoption. Then the observed adoption choice for an agricultural technology is likely to be the result of a complex set of inter-actions between comparable technologies and farmers' socio-economic, institutional and demographic characteristics.

Literature reviewed by the researcher revealed that adoption of rice production practices could be influenced by many micro, meso and macro level factors, including availability of resources (natural, human, technological, capital), constraints (bio physical, socio-economic), and policy environment (including land rights, land tenure, subsidies, taxes, commodity prices, transportation and marketing opportunities). In relevance to the objectives of this study, those explanations and findings are summarized under social, economic and institutional perspectives.

In this study, it is therefore assumed that rice farm practices are ecologically feasible, economically efficient, and socially compatible in the study area. Small scale rice farmers, practicing recommended technologies are a better option than the use of traditional methods and expect that farmers who adopt these technologies will continue to adopt in the future. Based on the intensity of adoption rice farm practices, the farmers are categorized as adopters, partial adopters and non-adopters.