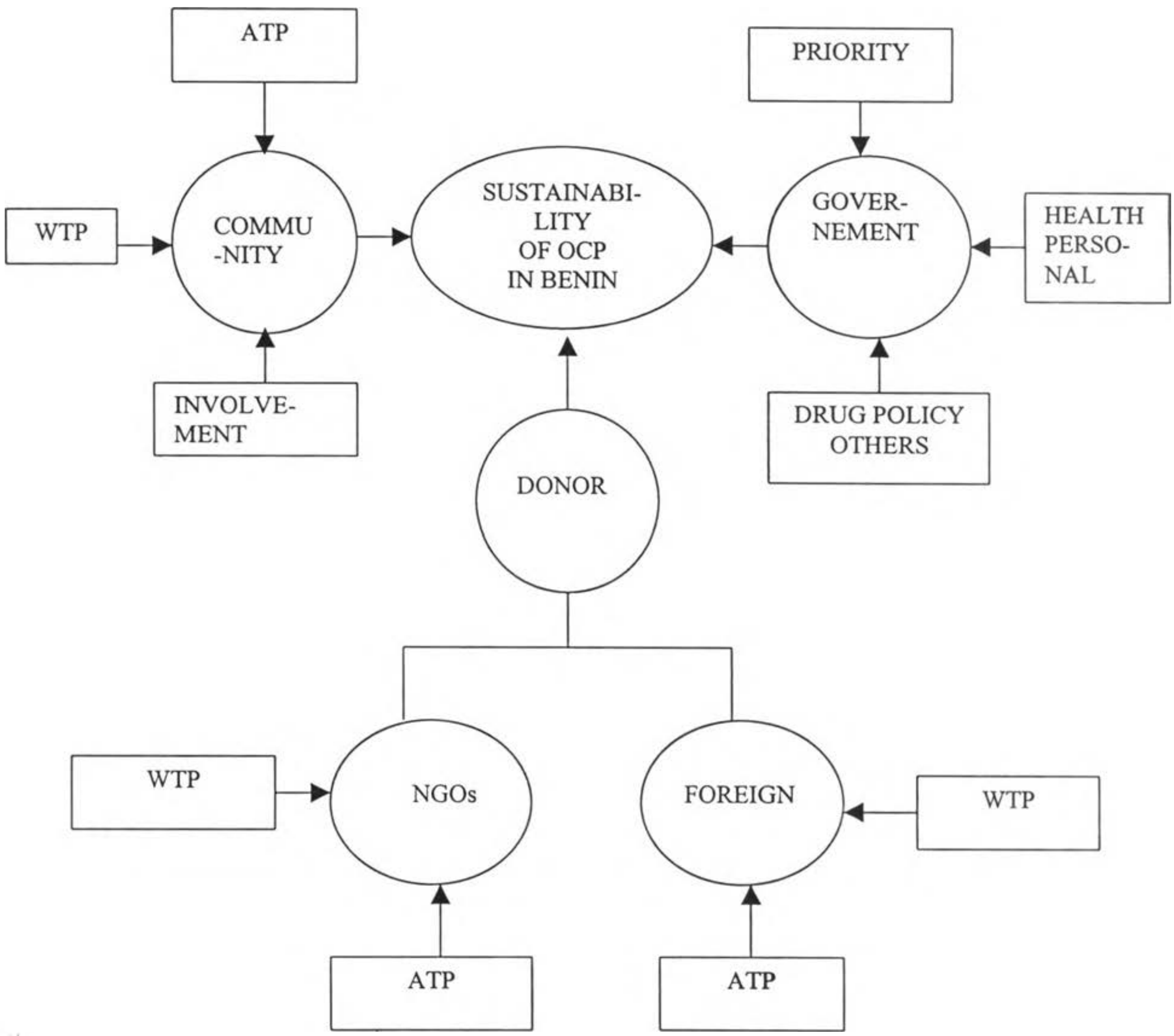
CHAPTER 3

RESEARCH METHODOLOGY

3.1 Conceptual framework of the study

Figure 1 Conceptual framework

This study has to answer how to model the sustainability of onchocerciasis control program



Three main dimensions are part of sustainability:
effectiveness of the system
efficiency of services
financial viability

This framework shows the three main pillars, which depend on the effectiveness of the system, efficiency of services and the financial viability of onchocerciasis control program (community, government and donors).

Community

Their capacity to support this program through their involvement, their willingness and ability to pay is one of the pillar which depend on the sustainability of onchocerciasis control in Benin, in the actual socioeconomic condition. This study will focus specially on this part.

Government and Donors

They are the second and the third pillars for the sustainability of onchocerciasis control program. Due to time constraint this study will not take account of these two parts.

Seeing that Onchocerciasis Control Program in West Africa is an example of effective public health management (Samba, 1994); this study will focus more on the financial viability.

3.2 Framework for the study

3.2.1 Study design

The design is a methodological-descriptive study, cross-sectional survey with the aim to identify and describe factors of relevance to the sustainability of OCP.

This study will develop a practical and simple approach for determining whether communities have the ability and willingness to bear the cost of onchocerciasis control with ivermectin and their involvement in this control.

In the design of the new approach, ability to pay and willingness to pay will be treated as separate though related issues and thus always estimated separately. However, the results will be combined using criteria to be developed to arrive at conclusions.

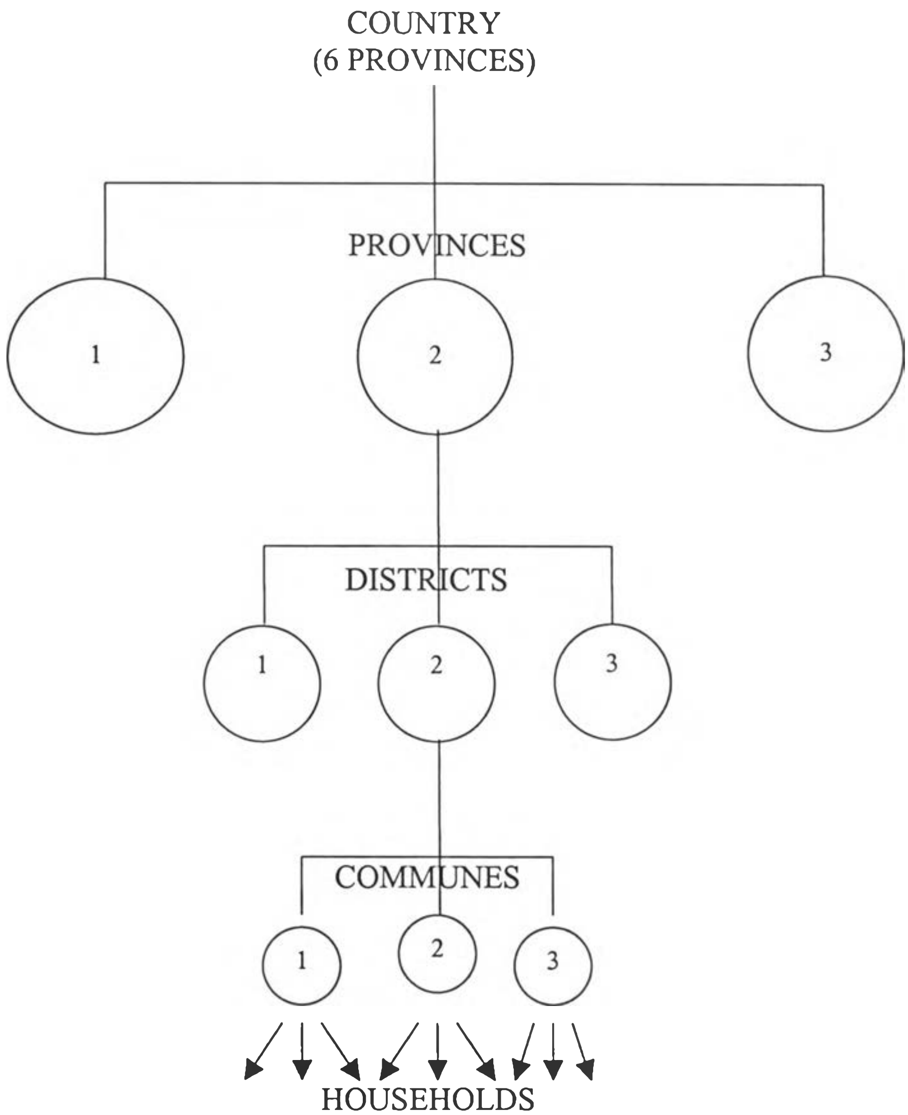
Also behavioral and health status factors that can affect utility maximization in financing onchocerciasis control will be modeled.

3.2.2 Study population

The target population in this study is all communities who lived in endemic onchocerciasis area in the country. The study population is the population of the three provinces where ivermectin treatment is indicated. The study unit is the household as well as the OCP responsible.

3.2.3 Sampling technique

Figure 2: Sampling technique



The sample will be drawn in four stages.

- First stage the three provinces (where onchocerciasis occurred and large-scale ivermectin treatment is indicated) will be selected.
- Second stage: In each province 3 districts (where onchocerciasis manifestations is highest, middle and lowest) will be selected.
- Third stage: Three communes are taken from each selected district. Each Commune in the district is given the same chance of being chosen. In all a sample of 9 communes will be selected at random, for the study.

- Fourth stage: the sampling unit is the household and persons to be interviewed are head of household and / or the caretaker. At this stage the determination of sampling size is based on the probability approach using the technique of disproportional stratified sampling. It permits the allocation of the sample size according to the analytical considerations. For example, this probabilistic sampling technique allows the good representation of the poor as well as the rich families in the sample.

Since in this descriptive study it is very difficult to generate an aggregate index representing various measures of association, and based on the statistical convenience, the determination of the sample size is based on the formula.

N /each commune $= [2Z/(Z_u - Z_l)]^2 + 3$

Where $Z_u = .5*\ln [(1+R_u)/(1-R_u)]$
$Z_l = .5*\ln [(1+R_l)/(1-R_l)]$

Assuming that our:
Upper limit of population correlation $R_u = .87$
Lower limit of population correlation $R_l = .67$
Level of significance $p = 0.05$

N/each commune = 58
N (total) = 58 x 9 = 522 households

The N households to be interviewed will be distributed in the total villages proportionally to the size of the population of each selected village. But we will use only a hypothetical sample of about 400 households to test the model

3.2.4 Sources of data

Primary data: on household ability and willingness to pay as well as the engagement of the community direct treatment with ivermectin.

Secondary data : collected from :
Annual report of MOPH
Report of OCP
Studies survey on Onchocerciasis control program

3.2.5 Designing the questionnaire for variables of the models

The basic principles in designing the final questionnaire are both relevancy and accuracy. Information will be gathered using in-depth interview especially general interview guide approach. We will do some focus group interview to valid information collected.

The corner stone of this study will be the formulation of an appropriate quantitative model comprising of household demand function for onchocerciasis control, ability to pay, willingness to pay and community's involvement functions. Since there are attributes relating to preferable utility states and the budgetary constraints to attaining such states.

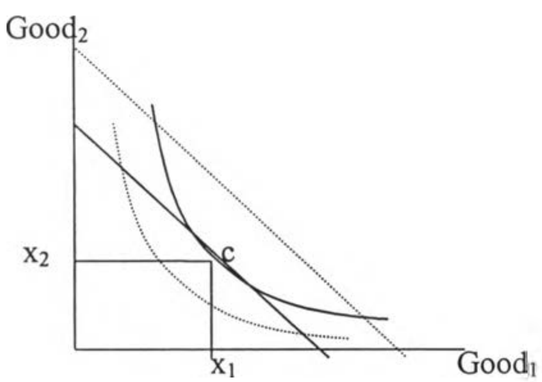
We will use the Hicksian demand function. The compensated demand function tells us what consumption bundle achieves a target level of utility and minimizes total expenditure. Hicksian demand functions are not directly observable since they depend on utility, which is not directly observable.

While WTP will be derived from the utility function especially in relation to compensating variation (CV) and equivalent variation (EV), ATP will be derived from the budgetary constraints of this utility function.

$V(p, y) = \max u(x)$ such as $px = y$ (1)
V is the indirect utility function

As showed in Figure1, normally a consumption bundle that maximizes utility will also minimize expenditure.

Figure 3: Utility curve given the budget constraint



Point c represents the highest utility level that can be reached by the individual, given the budget constraint. The combination x_1, x_2 is therefore the rational way for the individual to allocate purchasing power.

Slope of budget constraint = Px_1 / Px_2 = slope of indifference curve

To maximize utility, the consumer must take account of factors other than his or her own tastes. Following Lavy and Quigley (1993) quoted in Obina E. (1995), it is assumed that consumers derive utility from their medical and health status (M), a numerous good (X) and leisure (L). $U = U(M, X, L)$ (2)

This is slightly different from simple utility maximizing model, and a reasonable representation of it, is the n-good case. When there are n goods to choose from, the individual's objective is to maximize utility from those n goods:

Utility = $U(X_1, X_2 \ldots X_n)$, subject to the budget constraints

$Y = P_1X_1 + P_2X_2 + \ldots + P_nX_n$. (3)

Maximize $U = U(m, x)$ subject to $P_m m + P_x x = Y$ (4)

U = utility
m = constant quality unit of medical goods
x = a composite of all other goods
P_m = price of a unit of medical goods
P_x = price of a unit of other goods
Y = individual income, which is completely exhausted by expenditure on h and x.

In the OCP case we assume that there are two goods: Medical services (m) and all other goods (x) subject to the budget constraint.

By optimization, the first order condition of utility maximization with the budget constraint, an individual's demand for good (say x_1) depends on the shape of the utility function and on all prices and income:

$X^*_1 = D_1(P_1, P_2, \ldots, P_n, Y)$. (5)

Let us consider the utility maximization

$v(p,y^*) = \max u(x)$ such that $px < y^*$

Where $v(p,y^*)$ is indirect utility function

Let x^* be the solution to this problem and let $u^* = u(x^*)$. Consider the expenditure minimization

$e(p,u) = \min px$ such that $v(x) \geq u^*$

An inspection of Figure3 shows that in non-perverse cases the answers to these two problems should be the same x^*.

Then we can conclude:

- $e(p,v(p,y)) = y$ the minimum expenditure necessary to reach utility $v(p,y)$ is y

- $v(p,e(p,u)) = u$ the maximum utility from income $e(p,u)$ is u

- $x_i(p,y) = h_i(p,v(p,y))$ the marshallian demand at income y is the same as the Hicksian demand at utility v(p,y)

- $h_i(p,u) = x_i(p,e(p,u))$ the Hicksian demand utility u is the same as the Marshillian demand at income e(p,u).

This last ties together the "observable" Marshallian demand function with the "unobservable" Hicksian demand function. It shows the Hicksian demand function, the solution to the expenditure minimization problem is equal to the Marshallian demand function at an appropriate level of income. The Hicksian demand function is simply the Marshallian demand functions for various goods if the consumer's income is "compensated" so as to achieve some target level of utility.

Roy's identity. If x (p,y) is the Marshallian demand function, then

$$x_i(p,y) = -\frac{\dfrac{\partial v(p,y)}{\partial p_i}}{\dfrac{\partial v(p,y)}{\partial y}} \quad \text{for } i = 1,\ldots,k \qquad (6)$$

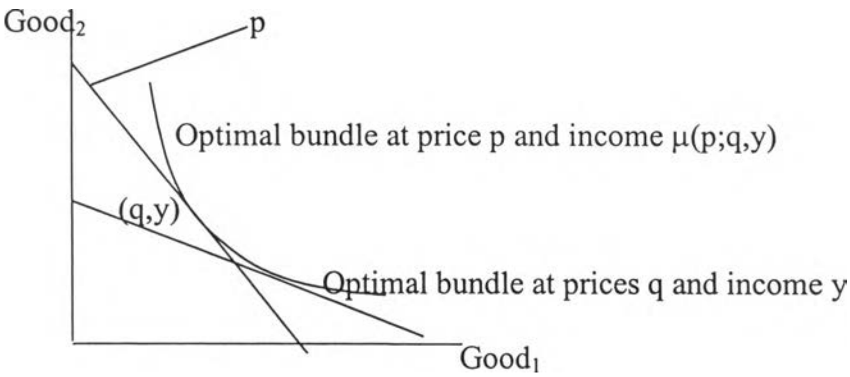
We assume that pi > 0 and y >0

There is a nice construction involving the expenditure function that comes up in a variety of places in welfare economics. One construct of indirect utility function is known as the money metric indirect utility function. It is given by

$\mu(p;q,y) = e(p,v(q,y))$.

That is, $\mu(p;q,y)$ measures how much money one would need at prices p to be as well off as one would be facing prices q and having income y. Just as in the direct case $\mu(p;q,y)$ behaves like an indirect utility function with respect to p, but now it behaves like an indirect utility function with respect to q and y, since it is after all, simply a monotonic transformation of an indirect utility function. Figure 4 shows a graphical example.

Figure 4: monotonic transformation of an indirect utility function (a graphical example)



A nice feature of the direct and indirect compensation functions is that they contain only observable arguments. Therefore we will use this tool to derive household willingness and ability to pay for onchocerciasis control using the Cobb-Douglas utility function.
The Cobb-Douglas direct utility function is given by: $u(m, x) = m^a x^{1-a}$
Since any monotonic transform of this function represents the same preferences, we can also write:

$$\ln u(m, x) = a \ln m + (1-a) \ln x \qquad (7)$$

The expenditure function and Hicksian demand function are equivalent. The Marshallian demand functions and the indirect utility function can be derived by solving the following problem:

$$\max a \ln m + (1-a) \ln x \qquad (8)$$

subject to $p_m m + p_x x = y$

The first order conditions for utility maximization are

$$(a/h) - \lambda p_m = 0$$

$$((1-a)/ x) - \lambda p_x = 0$$

or $a/ p_m m = (1-a)/p_x x$

Cross multiply and use the budget constraint to get the second Marshallian demand:

$$ap_x x = p_m m - a p_m m$$

$$ay = p_m m$$

$m(p_m,p_x,y) = ay/p_m$ (9)

Substitute into the budget constraint to get the second Marshallian demand:

$x(p_m,p_x,y) = ((1-a)y)/p_x$ (10)

Substitute into the objective function and eliminate constants to get the indirect utility function:

$\ln v(p_m,p_x,y) = \ln y - a \ln p_m - (1-a) \ln p_x.$ (11)

Econometric estimation

1. Onchocerciasis control demand function

According to Stuart and Steven (1980) (quoted in Njoumeni 1996) demand analysis is used to assess the desire of public for a certain level of medical service or health education. The authors mentioned that while many commentators on health problems discuss concepts of "need" in terms of societal health problems that should be corrected, economists focus on demand, or willingness of people to pay for a service.

Demand is the relationship between the various possible prices of a product and the amounts of it that consumers are willing an able to buy during some period of time, other things equal.

In the case of onchocerciasis control, the price of ivermectin is the most important variable in its demand function. According to Walter N. (1985) all good provide some satisfaction to consumers; presumably they derive some welfare from those items that they demand, and economists study how choices are made among them. There may be a "higher order" of demands for the necessities of life. For onchocerciasis control we assume that the number of persons that a household is willing and able to treat varies inversely with the price of the drug. Seeing that ivermectin is a normal good household demand will obey the low of demand.

From (5) $M = D_m(p_m, p_x, y)$

Following money metric indirect utility function, and the Cobb-Douglas utility function

$v(m,x) = m^a x^{1-a}$, thus we have:

$\ln v(m,x) = a\ln m + (1-a)\ln x$

$m(p_m\ p_x\ y) = ay/p_m$ (Onchocerciasis control demand) (12)

Now it is likely that estimating the regression will give us good estimates of a; then we can derive the WTP from the indirect utility function and the Roy's identity.

$\Sigma m_i = D_m$ existing P_x^o, P_m^o, $\bar{Y}$

$m_i = a\ Y/P_h$

$x_i = bY/P_x$

Where
m = medical service demanded
P_m = price of treatment
Y = household income
P_x = price of other goods

2. WTP

Continuing from (2) the medical and health status of a person or household in onchocerciasis endemic area is a function of many factors. Thus:

M = M(P,X)

P = health care services
X = A composite of other types of services or demand.

Assuming that onchocerciasis control is preventive in nature, then:

$P = P(O_c, O_s)$

O_c = Onchocerciasis control
O_s = Other health care services

The factors that affect the perception of households towards onchocerciasis control, and hence the utility to be derived from financing, its control are multi-dimensional. These factors may stem from level of knowledge and beliefs about the disease (Lk); their priority ranking (Pr); their level of exposure to the disease (Le); their perceived risk of contracting the disease (Rc) and the transportation cost (Tc).

These perceived health status and behavioral factors in turn determine the amount of funds a household is prepared to expend for the disease control. A household will find difficult to contribute to something if they are ignorant of the expected utility or benefit they will gain and vice versa. This assumption is general but it is not the rule.

There is a direct relationship between the amount he is willing to pay, health status and behavioral factors. That is the perceived need increases, the amount of funds the households will be willing to pay will be more.

Perceived need also increases if the level of knowledge, the level of exposure to the disease and the perceived risk of contracting the disease increase. The perceived need determines the expenditure.

Therefore, in deciding on whether an utility maximizing individual or household will make an expenditure to finance the control of onchocerciasis, the factors should be combined such as:

$$WTP = W(E(Lk, Pr, Le, Rc, Tc)) \qquad (13)$$

From the sample of household we hypothesize that for onchocerciasis control, the output of number of person treated with ivermectin on household i (H_i) depends on the level of knowledge and beliefs about the disease (Lk), the priority ranking (Pr), the level of exposure (Le), their perceived risk of contracting the disease (Rc) and the transportation cost to receive ivermectin (Tc).

Thus the number of people treated (medical service demanded) is tied to the willingness to pay.

The number of person a household is willing to treat is assumed to be a function of factor identified above as shown by the function below:

$$M = M(Lk, Pr, Rc, Le, Tc) \qquad (14)$$

Where:

M is the medical service demanded (dependent variable)

The independent variables are:

Lk represents the level of knowledge about onchocerciasis
Pr represents priority ranking
Rc represents risk of contracting onchocerciasis
Le represents the level of exposure
Tc represents the transportation cost

The amount a household is willing to pay is the number of people, he or she wants to treat times the price of treatment per person.

Following the money metric indirect utility function and the Cobb-Douglas utility function discussed earlier; we obtain onchocerciasis control demand function

$m = ay/p_m$ (Onchocerciasis control demand)

where m is number of person treated. m depends on the level of exposure, the level of knowledge, the priority ranking ...Thus the WTP for onchocerciasis control is correlated with onchocerciasis control demand which is derived from the indirect utility function. The factors that influence the WTP affect also onchocerciasis control demand, therefore the indirect utility function; and the minimum expenditure necessary to reach this indirect utility v(p,y) is y. The factors, which determined the WTP can shift the demand curve.

In order to incorporate the qualitative independent variables in the regression model, they must be quantified in some manner. This may be accomplished through the use of what is known as dummy variables. The dummy variable is a variable that assumes only a finite number of values (such as 0 or 1) for the purpose of identifying the different categories of a qualitative variable. According to Daniel (1995), the term "dummy" is used to indicate the fact that the numerical values (such as 0 or 1) assumed by the variable have no quantitative meaning but are used merely to identify different categories of the qualitative variable under consideration. Tables 4, 5 and 6 show the dummy variables that might influence the number of people treated in a household at the community level in Benin.

3. ATP

Ability to pay (ATP) must appear with the desire for a good or service before actual consumption can take place (Sher and Pinola, 1986). According to the authors, a consumer's ability to pay involves two things: the consumer's income and the price of commodities and hence both things must be brought into the theory of choice to complete it

Ability to pay can be seen as the budget constraint in the households' utility maximizing decisions, and will be derived from that expression. It is also known that each consumer spends his or her income in the way that yields the greatest amount of satisfaction or utility. Thus:

From equation (3) $Y = PM + QX$

Y = individual income which is completely exhausted by expenditures on X and M. However, in this research the unit of analysis is the household and therefore Y = Household income.

While $e(p,v(p,y)) = y$ the minimum expenditure necessary to reach utility v(p,y) is y

In this study a household has an ability to pay if y is above the poverty line. The ability to pay is correlated with the expenditure. Either someone has an ATP or not affects directly the indirect utility function. At an existing level of income some people have ability to pay and others no ability to pay; the matter of price change will move m along the curve of demand.

Household income is function of many factors; it will not be rational to consider only cash income of the households as the only budget constraint when carrying out studies in disease endemic areas, most of which are in the rural areas. Most of the household occupations are farmer, fisher, stockbreeder and other non cash-income yielding ventures. Therefore an index of budgetary constraints that interplay in a household should be used to get a better understanding of utility maximization constraints.

thus

$$ATP = A(O_p, T_s, F_s, S_y,) \qquad (15)$$

O_p = Ownership of property
T_s = Type of saving
Fs = Family size
S_y = Source of income or occupation

According to a socio economic survey did by CREDESA (1989) the poverty line in Benin is F CFA 50, 000. ATP is defined as follows.

If Y_h < poverty line (F 50,000) ATP = 0 (no ability to pay)
$Y_h \geq$ poverty line (F 50,000) ATP = 1 (ability to pay)

When Y_h = Household income

Thus the minimum expenditure necessary to reach utility v(p,y) is influenced by ATP factors (ownership of property, type of saving, the family size), which can shift the demand curve.

Household income = Y_h

It can be cash or non-cash income. Cash income is measured in monetary unit. The market price shall be used in valuing non-cash income. Income represents the balance of all types of incomes and transfers of a household during the last twelve months. It includes:

- Wages (from wage earning activities),
- Bonuses and benefits from wage earning activities
- Medical and maternal allocations (from wage earning activities)
- Income from self–employment (income of non farm family enterprises)
- Scholarships (for education if any)
- Income for rental of land or housing (if any)
- Income from various kinds of pensions (occupational status)
- Dividends to shareholders (if any)

- In kind payments (from wage earning activities)
- Income from farming (farming production)
- Income from selling cattle (if any)
- Other income (if any)

Ownership of property (Op)

This is measure of wealth and it is normally highly correlated with income. Ownership of property gives an indication of the ability; since income is sometimes transient. Therefore depending on the type of property a household owns, the ability could be deduced.

Type of savings (T_s)

Savings include the money a family saved either in the formal financial institutions (e.g. banks) or informal banking schemes (e.g. informal family's saving schemes). They include also food stores and non-food crops (surplus farm produce).

This is a proxy variable for the amount of savings a household has. This because while nobody will readily reveal the amount of savings he has, the type of saving scheme they are patronizing will give an indication on the amount of saving they have. Saving is a form of asset and it might imply an enhanced capacity of households to use health care services and possibly to afford higher quality services than income alone suggests (Akin and others, 1985 quoted in Obina, 1995).

The various types of saving mechanism give an indication of how much someone has. Thus, household with little savings usually saves with friends in a special type of scheme. Most people who have a lot of money save with the banks. However there are some exceptions to the rules above.

Family size (F_s)

Family size represents the number of people living in the household during the last twelve months. The size of family will influence the ability to pay of the household.

Source of income (S_y)

Source of income is qualitative variable representing the main activity which is generates income to family. The ability to pay has a relationship with the source of income; if it is permanent or not.

We can say the ability to pay has a direct influence on medical service demanded (number of people treated.)

4. Community Involvement

To maximize impact on health status with very limited available resources, the community should be involved. Community direct treatment with ivermectin is one way to success in onchocerciasis control. Community direct treatment with ivermectin has been successful in a wide range of geographical and cultural setting in Africa (Nigeria, Cameroon, Ghana, Mali and Uganda). Although sustainability depend on the high degree of Community involvement (TDR News, 1997).

But community involvement (CI) depend also on many factors such as perceived benefit of ivermectin, a good leadership, availability of credible distributors et cetera; therefore

$$CI = C\,(D_s, A_d, C_l, P_b, I_h) \qquad (16)$$

D_s = Designing distribution system and selecting distributors by community
A_d = Availability of credible distributors
C_l = Community leadership to facilitate effective functioning of the distribution system
P_b = Perceived benefits of ivermectin
I_h = Integration with the local health system

D_s

The distribution system is designed by members of the communities, or their representatives, is an indicator of communities involvement. Even where the distribution system is initiated from outside, the communities participated in the selection of the distributors is a good criteria for communities involvement.

A_d

The choice of distributors can be the responsibility of the community or the government. By selecting individuals who are perceived to be credible, the community is able to identify with the program.

C_l

Even though the style of leadership varied, good leadership was an important determinant of successful distribution. Communities relied on their leaders to take important decisions on their behalf. Leadership is necessary to motivate people to participate in the program and to follow up when necessary to ensure their communities received ivermectin.

P_b

If the villagers is eager to take ivermectin and considered it a helpful drug; even when side effects were acknowledged; the community involvement should be more.

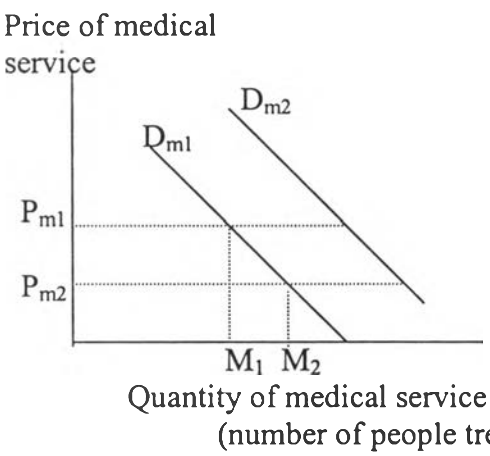
I_h

It may not always be possible or desirable to fully integrate activities with the existing program. It is nevertheless desirable to avoid competition and conflict; because conflict will affect community involvement.

In conclusion

The estimate of demand for a service is basically a price-quantity relationship, as shown in Figure 5. For any of the demand curves depicted (these are assumed to be linear), demand decreases as the price of the service increases, and vice versa. For demand curve D_{m1}, a decrease in price from P_{m1} to P_{m2} will be accompanied by an increase in demand to M_1 to M_2. In case of onchocerciasis control the position of demand curve is affected by a variety of factors of WTP, ATP and CI including income, prices of others goods.

Figure 5: Onchocerciasis control demand curves



If any of these factors (equations 13, 15 and 16) change, the demand curve (equation 12) will shift to a different position. Government policies of subsidization of onchocerciasis control will cause movements along a specific curve; for example, (P_{m1},M_1) to (P_{m2},M_2) on curve D_{m1}. Public health programs, by increasing the level of knowledge about onchocerciasis for example, will cause a shift in demand curves (from curve D_{m1} to D_{m2}). A change of ATP, WTP and CI factors may have a great impact on demand.

Therefore we have to examine ATP, CI, WTP and onchocerciasis control demand functions at the same time because they have some relationships.

3.3.5 Estimation methods of onchoceriasis control demand function, CI, WTP and ATP

As state in the conceptual framework, the ultimate evaluative test for community involvement, willingness to pay and ability to pay is how accurate it is, in predicting sustainability of the onchocerciasis control program. Different levels of CI, WTP and ATP are assumed for rich and poor in each community. Therefore we will do some sensitivity analysis seeing that many studies looked at household expenditure on health showed that there is no significant difference in median health expenditure between the socioeconomic groups; the poor spent similar amounts as the rich. (Soucat et al. 1991).

Onchocerciasis control demand function

$$m_i = a\, Y/P_m + c$$

We will estimate it using ordinary least square. Regression analysis helps to determine the relationship between variables. The objective of this method of analysis here is to estimate the coefficient of the demand function.

Willingness to pay

Equation (17) of WTP

$$M = \alpha_0 + \alpha_1 Lk + \alpha_2 Pr + \alpha_3 Rc + \alpha_4 Le + \alpha_5 Tc \qquad (17)$$

We will estimate it using ordinary least square. The aim is to estimate α_0, α_1, α_2, α_3, and α_4 Of course, this can be accomplished with other forms of equations but here the interaction term is a simple and direct option.

Ability to pay

Equation (18) of ATP

$$ATP_h = \beta_0 + \beta_1 O_p + \beta_2 T_s + \beta_3 F_s + \beta_4 S_y \qquad (18)$$

We will estimate it by binary choice model, especially logit model, which is based on the cumulative logistic probability function.

Community involvement

Some explanatory variables in the multiple regression, the dummy variables e.g. perceived benefit of ivermectin are dichotomous in nature. As well as community involvement can be explained by the positive or negative perceived benefit of ivermectin, the community involvement can also explain the positive or negative perceived benefit of ivermectin.

Equation (19) of CI

$$CI = \gamma_0 + \gamma_1 D_s + \gamma_2 A_d + \gamma_3 C_l + \gamma_4 P_b + \gamma_5 I_h \qquad (19)$$

We will estimate it by binary choice model, logit model, which is based on the cumulative logistic probability function.

Testing the statistical significance of the slope coefficient

In the logit analysis, using the t-tests can test the hypothesis.

H_0 : $\beta = 0$ there is no relationship between the perceived benefit of ivermectin and the percentage of person a household want to treat. The alternative is H_a: $\beta \neq 0$ there is a relationship between the perceived benefit of ivermectin and the percentage of person a household want to treat.

Table 5: WTP: variables (proxied by ordinary least square)

Variables	Qualitative factors	Number of categories	Dummy variables
X_1	Level of knowledge (Lk)	No knowledge	$x_{1.1}$ { 1 = no knowledge; 0 = otherwise
		Fair knowledge	$x_{1.2}$ { 1 = fair knowledge; 0 = otherwise
		Good knowledge	if $x_{1.1} = x_{1.2} = 0$ then good knowledge
X_2	Priority ranking (Pr)	Not a priority	$x_{2.1}$ { 1 = not a priority; 0 = otherwise
		Low priority	$x_{2.2}$ { 1 = Low priority; 0 = otherwise
		Priority	if $x_{2.1} = x_{2.2} = 0$ then Priority
X_3	Presence of Clinical onchocerciasis In household member	Not present	$x_{3.1}$ { 1 = not present; 0 = otherwise
		Present on 1 Household member	$x_{3.2}$ { 1 = present on 1; 0 = otherwise
		Present on many Household members	if $x_{3.1} = x_{3.2} = 0$ then present on many household members
X_4	Risk of an individual Contracting onchocerciasis	No risk	$x_{4.1}$ { 1 = no risk; 0 = otherwise

		Low risk	1 = low risk $x_{4.2}$ { 0 = otherwise
X_5	Transportation cost	High risk	if $x_{4.1} = x_{4.2} = 0$ then high risk

Table 6: ATP: variables (proxied by binary choice model)

Variables	Qualitative factors	Number of categories	Dummy variables

X_6	Ownership of property	Owns no property
		
		Owns personal home Or farmland+ bicycle
		
		Owns personal home + TV + refrigerator + farmland + motor vehicle
			1 = owns no propertyge
			$x_{5.1}$ {
			0 = otherwise
			
			1 = owns personal ...
			$x_{5.2}$ {
			0 = otherwise
			
			if $x_{5.1} = x_{5.2} = 0$ then owns personal home + TV + refrigerator + farmland + motor vehicle

X_7	Type of saving	No saving
		
		Saving with friend, In home or with Cooperative
		
		Saving with bank
			1 = no saving
			$x_{6.1}$ {
			0 = otherwise
			
			1 = saving with friend
			$x_{6.2}$ {
			0 = otherwise
			
			if $x_{6.1} = x_{6.2} = 0$ then saving with bank

X_8	Sources of income	Permanent	$x_{7.}$ { 1 = permanent; 0 = non permanent
X_9	Family size	Less than 4 persons	$x_{8.1}$ { 1 = ≤ 4 persons; 0 = otherwise
		Between 4 – 7	$x_{8.2}$ { 1 = between 4 – 7; 0 = otherwise
		More than 7 persons	if $x_{8.1} = x_{8.2} = 0$ then more than 7 persons

Table 7: CI: variables (proxied by binary choice model)

Variables	Qualitative factors	Number of categories	Dummy variables
X_{10}	Community involvement In designing distribution System and selecting Distributor	Yes No	$x_{9.1}$ { 1 = yes; 0 = no
X_{11}	Availability of credible Distributors	Yes No	$x_{10.1}$ { 1 = yes; 0 = no
X_{12}	Community leadership To facilitate effective Effective functioning of The distribution system	Yes No	$x_{11.1}$ { 1 = yes; 0 = no
X_{13}	Perceived benefit of Ivermectin	Yes No	$x_{12.1}$ { 1 = yes; 0 = no
X_{14}	Integration with the local Health system	Yes No	$x_{12.1}$ { 1 = yes; 0 = no

3.4 Data collection

Cross sectional data are to be collected for this study. Time constraints do not permit us to collect the real data for this purpose. However, some hypothetical data generated from different household survey in Benin will be used to test the credibility of the models.

3.5 Variables of the model and their measurements

Ability to pay

Table: 8 ATP variables and their measurement

Variables	How to measure	Sources
1. Household income	Questionnaire:	Q2.1
2. Ownership of property	.Owns no property = 1 .Owns personal home or and farmland + bicycle = 2 .Owns personal home +television +refrigerator and farmland plus motor vehicle = 3	Q3.1
3.Type of saving	No saving = 1 Saving with friend or in home Or with cooperative = 2 Saving with bank = 3	Q3.2
4.Sources of income	Non permanent =1 Permanent =2	Q3.4
5.Family size	Less than 4(persons) = 3 Between 4-7 = 2 More than 7 = 1	Q3.3

Willingness to pay

Tables: 9 WTP variables and their measurement

Variables	How to measure	Sources
1. Level of knowledge About onchocerciasis	-No knowledge =1 -Fair Knowledge =2 -Good knowledge =3	Q4.1
2. Priority ranking of onchocercisis	-Not a priority =1 -Low priority =2 -Priority = 3	Q4.2
Presence of clinical onchocerciasis in Household member(s)	-Not present =1 -Present in household member =2 -Present in many household members = 3	Q4.3
Risk of an individual or Household contracting onchocerciasis	-No risk =1 -Low risk =2 -High risk =3	Q4.4
5. The maximum amount a person is willing to pay or contribute (Transportation cost)	Questionnaire:	Q2.1.6

Let the level of knowledge and beliefs be represented by level of knowledge about onchocerciasis (Lk) and priority ranking of the disease (Pr)
Let level of exposure to the disease be represented by presence of clinical onchocerciasis in an individual or household member (Pc)
Let perceived risk be represented by risk of an individual or household member contracting onchocerciasis (Rc).

Community involvement

Table: 10 CI variables and their measurement

Variables	How to measure	Sources
1.Community involvement in designing distribution system and selecting distributors	Yes =1 No =0	Q5.1
2.Availability of credible distributors	Non =0 Exist =1	Q5.2
3.Community leadership to facilitate effective functioning of the distribution system	Non =0 Exist =1	Q5.3
4.Perceived benefits of ivermectin	Yes =1 No =2	Q5.4
5. Integration with local health system	Yes =1 No =2	Q5.6

Data processing: computer software required

Econometric View 2.0 software program will be used to analyze the data. The question will be answered using the multiple regression technique. But the selection of the final multiple regression models will depend on the data collected during the survey.