

**Acceptance Analysis of New Technology for Sustainable Water  
Management and Sanitation**

***A Case Study of Operating Farm Households  
in the Mekong Delta, Viet Nam***

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## **Abstract**

Recent development in agricultural and industrial production leads to increasing pollution of the water sources in the Mekong Delta of Vietnam. According to the "Vietnam Environment Monitor 2003 – Water", no safe drinking water is provided to approximately 40 % of the total population. Thus, environmental institutions and governments became aware of the looming fresh water crisis. As a result, the "National Rural Clean Water Supply and Sanitation Strategy" (NRWSS) was elaborated as part of the national "Poverty Reduction Strategy Paper" to take responsibility for the Millennium Development Goals.

The reuse of waste/wastewater for agriculture may be a low cost solution in water treatment and at the same time a significant contribution to food production. The presented socio-economic study was conducted during the course of the interdisciplinary SANSED-Project in 2003/04, aiming to identify criteria for a sustainable wastewater treatment system. Therefore, User- and Non-User-operating farm households' (OFH) attitudes towards and acceptance behavior of biogas plants (BGP), modern latrines (ML) and biogas sludge (BGS) as principal components of an ecological wastewater management system were analyzed and evaluated. Referring to the latter, the use of human feces in the biogas technology was a major point of interest. By means of a detailed questionnaire, the survey aimed to achieve information about the OFHs' environment and interactions. LANGENHEDER'S decision-making-theory together with KOLLMANN'S use-acceptance-model on the OFH defined by DOPPLER as socio-economic system constitutes the basis of this research approach. Within the sample 218 OFHs in three selected communities of the Mekong Delta as well as representatives of the local government, universities and other institutions were interviewed. The study leads to the following results and recommendations:

80 % of the surveyed OFHs have no ML, 10 % have no latrine at all. Generally, the population is aware of the hygienic and environmental threats, but real commitments to solve the problem are still missing. The User OFHs dispose of a higher living standard and educational level. Apart from their farming activity, they hold down a non-farm job and thus, dispose of more steady income and have easier creditworthiness. The principal OFHs' problems are lack of capital and professional knowledge as well as shortcomings in the access to further training.

Most of the households know about the governmental intentions to substitute fishpond-latrines and to promote the use of organic fertilizer instead of untreated feces. In general the OFHs perceive BGP, ML and BGS-use as progressive, but restraining factors for their investment and sustainable utilization do exist. The principal restricting determinants are:

**BGP:** Lack of capital and therefore of a customized microfinance system, the dependency on piggery as substrate input source and its market instability as well as the lack of monitored construction quality standards and difficult emptying procedure of the system.

**ML:** Lack of economic inducement, ML-inappropriateness i.e. luxury good that doesn't fit to the living standard (average dwelling) on the countryside.

**BGS:** Lack of information, specifically nescience about BGS-use and earthworm breeding, difficult, space intensive and time-consuming handling, small produced quantity, relatively low market value.

The acceptance of these components suffer shortcomings in communication including reliable technical assistance and professional training using demonstration units for capacity building as well as choices of models for adaptability.

The Health Care Centre, the Agricultural Extension Service and research institutions should work closer together on the standardization and general widespread introduction of BGP with connected ML as it would provide an efficient solution with synergy effects reducing the installation and fix costs, superseding the emptying procedure, enabling the safe reuse of night soil and alleviating the strong dependency of BGP-utilization on piggery. The Agricultural Extension Service already tries to offer and transmit information accordingly, but the institutional structure and efficiency referring on its internal organization, available quantity of field service staff and its capacity are insufficient.

Further recommendations to improve the acceptance and dissemination rates include the establishment of user-societies/groups, demand-oriented offers of custom-to-fit-system, economic inducement and service network for microfinance at the grassroots level. The second phase of SANSED-Project offers the opportunity to consider the recommendations and to tackle the need for acceptance and dissemination research.

## Tóm lược

Quá trình phát triển trên các lĩnh vực sản xuất nông nghiệp và công nghiệp đã dẫn đến sự ô nhiễm những nguồn nước tại Đồng bằng Sông Cửu Long. Theo „Báo cáo Môi trường Việt Nam 2003 – Nước“ thì có đến khoảng 40% tổng số dân chúng không có nước uống sạch. Những cơ quan chính phủ và những tổ chức môi trường ngày càng ý thức rõ về tình trạng khủng hoảng đối với nước ngọt này. Để có thể đáp ứng được những mục tiêu phát triển cho thiên niên kỷ mới, “Chiến lược Quốc gia Cấp nước sạch và vệ sinh nông thôn” (NRWSS) nằm trong „Chiến lược Quốc gia Giảm nghèo“ đã được biên soạn.

Việc tái sử dụng rác / nước thải trong nông nghiệp có thể là một hình thức xử lý nước hiệu quả và đồng thời cũng đóng góp không ít vào việc gia tăng sản xuất thực phẩm. Nghiên cứu về mặt kinh tế xã hội này được thực hiện trong khuôn khổ dự án SANSED liên ngành trong những năm 2003/04 với mục tiêu xác định những tiêu chuẩn cho một hệ thống xử lý nước thải bền vững. Nghiên cứu này nhằm phân tích và đánh giá lập trường và thái độ chấp nhận của các hộ sinh hoạt nông nghiệp (người sử dụng và người không sử dụng) đối với việc sử dụng những trang thiết bị biogas, nhà tiêu hiện đại và bùn biogas như là những thành phần thuộc hệ thống quản lý nước thải có tính sinh thái.

Trong bối cảnh này, cần quan tâm đặc biệt đến việc tái sử dụng phân người thông qua công nghệ biogas. Bằng một bảng câu hỏi chi tiết, việc thăm dò thu thập thông tin về những điều kiện khung của các hộ nông nghiệp và những hoạt động của họ. Nghiên cứu này được thực hiện trên cơ sở Lý thuyết LANGENHEDER về hành vi quyết định, Mô hình chấp nhận của KOLLMANN và Định nghĩa DOPPLER về những hộ nông nghiệp. Tổng cộng có 218 hộ nông nghiệp tại ba xã được lựa chọn ở Đồng bằng Sông Cửu Long, đại diện chính quyền địa phương, các đại học và các cơ quan khác được yêu cầu tham dự cuộc thăm dò. Nghiên cứu đạt được những kết quả và những khuyến cáo sau đây:

80% hộ nông nghiệp không có nhà tiêu hiện đại, 10% không có nhà tiêu nào cả. Nói chung, dân chúng có ý thức về những vấn đề vệ sinh và sinh thái, song vẫn còn thiếu các điều kiện thực tế để giải quyết vấn đề. Những hộ nông nghiệp có sử dụng thì thông thường có mức sống và trình độ văn hoá cao hơn trung bình. Ngoài lao động nông nghiệp, họ còn làm việc khác ngoài nông nghiệp nên có thu nhập thường xuyên hơn và được coi là đáng được cho vay tín dụng. Những vấn đề cốt lõi của các hộ nông nghiệp là thiếu vốn, không có đủ kiến thức chuyên môn và khả năng học tập bồi dưỡng còn rất hạn chế.

Đa số hộ hầu đều biết đến việc chính phủ thúc đẩy việc thay thế những „cầu tiêu ao cá“ và khuyến khích việc sử dụng phân hữu cơ thay vì phân để nguyên không qua xử lý. Trên nguyên tắc, những hộ nông nghiệp đều xem việc sử dụng trang thiết bị biogas, nhà tiêu hiện đại và bùn biogas là tiến bộ. Tuy nhiên vẫn tồn tại nhiều trở ngại để có sử dụng bền vững và phổ biến rộng rãi. Những hạn chế chủ yếu:

**Trang thiết bị biogas:** Thiếu vốn và chưa có đầy đủ hệ thống định hướng khách hàng; sự lệ thuộc một chiều vào chăn nuôi heo như là nguồn thu thập chất liệu, giá cả lên xuống thất thường, thiếu các tiêu chuẩn ấn định chất lượng về xây dựng, cài đặt, việc tháo chất thải từ trang thiết bị còn khó khăn.

**Nhà tiêu hiện đại:** Không có hấp dẫn về mặt kinh tế, tính không thoả đáng của nhà tiêu hiện đại (đắt tiền, không phù hợp với sinh hoạt và lối sống trong hộ gia đình nông thôn lâu nay).

**Bùn biogas:** Thiếu thông tin, nhất là về việc ứng dụng bùn biogas và nuôi giun; cách xử lý không thuận tiện, hao tốn thời gian và không gian, số lượng sản xuất còn kém, giá trị kinh tế xét chung vẫn còn thấp.

Nâng cao mức độ chấp nhận những thành tố kể trên của hệ thống xử lý nước thải cần một chiến lược tốt hơn, một sự hỗ trợ kỹ thuật đáng tin cậy và việc huấn luyện chuyên môn thông qua những đơn vị làm mẫu về phát triển khả năng cũng như sự lựa chọn những mô hình thích ứng. Trung tâm y tế, Dịch vụ tư vấn nông thôn và những cơ quan nghiên cứu nên cùng xác định những tiêu chuẩn chung về chất lượng và khởi xướng tiến hành thực hiện thiết bị biogas kết hợp với nhà tiêu hiện đại trên địa bàn rộng lớn. Đó có thể là một khởi điểm có hiệu suất cao mang lại nhiều hiệu quả hợp lực đối với chi phí tạo dựng, cài đặt, tháo chất thải của trang thiết bị biogas, tái sử dụng phân người cũng như giảm bớt mức độ lệ thuộc vào chăn nuôi heo trong việc sử dụng nhà tiêu hiện đại. Dịch vụ tư vấn nông thôn đã bắt đầu cung cấp những thông tin liên hệ và làm việc mỗi giới, nhưng cơ cấu tổ chức và năng lực hoạt động vẫn còn kém do thiếu nhân lực và đào tạo.

Những khuyến cáo tiếp theo nhằm cải thiện mức độ chấp nhận của dân và phổ biến phải bao gồm việc xây dựng những tập thể người sử dụng, cung ứng dựa trên nhu cầu về các hệ thống Custom-to-fit, những phương cách huy động và một mạng lưới cơ bản về cho vay tín dụng tầm nhỏ. Dự án kế tiếp SANSED II cung ứng khả năng thực hiện những khuyến cáo này và tiến hành nghiên cứu tiếp về mức độ chấp nhận và phổ biến.

## Kurzfassung

Die Entwicklung im landwirtschaftlichen und industriellen Produktionssektor führt zu zunehmender Verunreinigung der Wasserressourcen im Mekong Delta Vietnams. Dem "Vietnam Umwelt Monitor 2003 - Wasser" zur Folge verfügt etwa 40 % der Gesamtbevölkerung über kein sauberes Trinkwasser. Regierung und Umweltorganisationen wurden sich dieser zunehmenden Süßwasserkrise bewusst. Um den Millennium-Entwicklungszielen gerecht zu werden, wurde die "Nationale Strategie für ländliche Wasserversorgung und Sanitärwesen" (NRWSS) als Teil der nationalen "Strategie zur Armutsbekämpfung" erarbeitet.

Die Wiederverwendung von Abfall/Abwasser in der Landwirtschaft kann eine effiziente Form der Wasserbehandlung und gleichzeitig ein bedeutender Beitrag zur Steigerung der Nahrungsmittelproduktion sein. Die vorliegende sozioökonomische Studie wurde im Rahmen des interdisziplinären SANSED-Projektes in den Jahren 2003/04 mit dem Ziel durchgeführt, Kriterien für ein nachhaltiges Abwasserbehandlungssystem zu definieren. Es sollte die Einstellung und das Akzeptanzverhalten von landwirtschaftlichen Betriebs Haushalten (LBH, Nichtbenutzer und Benutzer) bezüglich der Nutzung von Biogasanlagen (BGA), modernen Latrinen (ML) und Biogasschlamm (BGS) als Hauptbestandteile eines ökologischen Abwassermanagementsystems analysiert und bewertet werden. Dabei war die Wiederverwertung von menschlichen Exkrementen mittels der Biogas-Technologie von besonderem Interesse. Anhand eines detaillierten Fragebogens zielte die Erhebung darauf ab, Informationen über die Rahmenbedingungen der LBH und deren Interaktionen zu erhalten. LANGENHEDER'S Theorie zur Entscheidungshandlung, KOLLMANN'S Akzeptanzmodell und DOPPLER'S Definition des landwirtschaftlichen Betriebs Haushaltes bildeten die Grundlage für den Forschungsansatz. Insgesamt wurden 218 LBHs in drei ausgewählten Dorfgemeinschaften des Mekong Deltas sowie Repräsentanten der lokalen Regierung, von Universitäten und anderen Institutionen befragt. Die Studie führt zu die folgenden Ergebnissen und Empfehlungen:

80 % der LBHs haben keine moderne Latrine, 10 % besitzen überhaupt keine Latrine. Im Allgemeinen ist sich die Bevölkerung der hygienischen und ökologischen Probleme bewusst, aber tatsächliche Ansätze zur Problemlösung sind unzureichend. Die Benutzer-LBHs verfügen generell über einen höheren Lebensstandard und ein höheres Bildungsniveau. Abgesehen von ihrer landwirtschaftlichen Tätigkeit gehen sie einer außerlandwirtschaftlichen Arbeit nach, haben folglich ein stetigeres Einkommen und sind eher kreditwürdig. Kernprobleme der LBHs sind Kapitalmangel, unzureichendes Fachwissen und begrenzte Möglichkeiten der Weiterbildung.

Die meisten Haushalte kennen die Regierungsabsichten, „Fischteich-Latrinen“ zu ersetzen und den Gebrauch des organischen Düngers anstelle von unbehandelten Exkrementen zu fördern. Grundsätzlich sehen die LBHs die Nutzung von BGA, ML und BGS als fortschrittlich an. Trotzdem bestehen Hindernisse für ihre nachhaltige Übernahme und Verbreitung. Die wesentlichen Determinanten sind:

**BGA:** Kapitalmangel und kein ausreichend kundenorientiertes Kleinkreditsystem; singuläre Abhängigkeit von der Schweinehaltung als Stoffeintragsquelle und dessen Preisschwankungen sowie Mangel an überwachten Qualitätsstandards der Installationen, schwierige Entleerung der Anlage.

**ML:** Kein ökonomischer Anreiz, ML-Unangemessenheit (Luxusgut, das nicht zum bisherigen Lebensstandard/Hausqualität auf dem Lande passt).

**BGS:** Informationsmangel, dies betrifft speziell die BGS-Anwendung und Regenwurmzucht; unkomfortable, raum- und zeitintensive Behandlung, geringe Produktionsmenge, verhältnismäßig niedriger ökonomischer Wert.

Die Erhöhung der Akzeptanzrate der o.g. Komponenten des Abwassermanagementsystems benötigt eine bessere Kommunikationsstrategie, eine zuverlässige technische Unterstützung und professionelles Training anhand von Demonstrationseinheiten zur Entwicklung der Kapazitäten sowie eine Auswahl an adäquaten Modellen. Die Poliklinik, der landwirtschaftliche Beratungsservice und die Forschungsinstitutionen sollten gemeinsam Qualitätsstandards festlegen und eine weiträumige Einführung von BGA mit ML-Anschluss initiieren. Dies wäre ein effizienter Ansatz mit Synergieeffekten in den Anschaffungskosten, der Installation, der Entleerung der BGA, der sicheren Wiederverwertung menschlicher Exkremente sowie der Verringerung der Abhängigkeit der BGA-Nutzung von der Schweinehaltung. Der landwirtschaftliche Beratungsservice versucht bereits entsprechende Informationen anzubieten und zu vermitteln, aber die Organisationsstruktur und Leistungsfähigkeit sind unzulänglich, da es an Personal und Ausbildung fehlt.

Weitere Empfehlungen zur Verbesserung der Annahme- und Diffusionsrate schließen die Einrichtung von Benutzergemeinschaften, nachfrageorientierte Angebote von Custom-to-fit-Systemen, ökonomische Stimuli und ein Basisnetzwerk für Kleinkredite mit ein. Das Folgeprojekt SANSED II bietet die Möglichkeit, die Empfehlungen umzusetzen und den weiteren Forschungsbedarf in den Bereichen Akzeptanz- und Diffusionsforschung anzugehen.

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***Florian Wieneke***





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## List of Abbreviations

<b>AB</b>	An Binh
<b>ADB</b>	Asian Development Bank
<b>ADCOM</b>	Vietnam Consulting Company for WSP
<b>ASEAN</b>	Association of South East Asian Nations
<b>AusAID</b>	Australian Agency of International Development
<b>BGP</b>	Biogas Plant
<b>BGS</b>	Biogas Sludge
<b>CC-BGP</b>	Biogas plant made of concrete and bricks
<b>CERPAD</b>	Centre for Residential Planning and Development
<b>CERWASS</b>	Centre for Rural Water Supply and Environmental Sanitation
<b>CMEA</b>	Council for Mutual Economic Assistance (also COMECON or MEA)
<b>CPVN</b>	Communist Party of Vietnam
<b>CTU</b>	Can Tho University
<b>DANIDA</b>	Danish International Development Assistance
<b>DAP</b>	(NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub> (flower stimulation)
<b>DARD</b>	Department of Agriculture and Rural Development
<b>DOLISA</b>	Department of Labor, Invalids and Social Affairs
<b>DOSTE</b>	Department of Science Technology and Environment
<b>DVC</b>	Double Vault Composting (latrine)
<b>FAO</b>	Food and Agricultural Organization
<b>GDP</b>	Gross Domestic Product
<b>GoV</b>	Government of Viet Nam
<b>GSO</b>	General Statistics Office of Viet Nam
<b>ha</b>	Hectare
<b>HA</b>	Hoa An
<b>Hhs</b>	Household(s)
<b>ICLARM</b>	The International Center for Living Aquatic Resources Management
<b>IEC</b>	Information-Education-Communication (activities)
<b>km<sup>2</sup></b>	Square kilometer
<b>LPG</b>	Liquefied Petroleum Gas
<b>LT</b>	Long Tuyen
<b>m<sup>2</sup></b>	Square meter
<b>m<sup>3</sup></b>	Cubic meter
<b>MARD</b>	Ministry of Agriculture and Rural Development
<b>MD</b>	Mekong Delta
<b>ML</b>	Modern Latrine
<b>MOC</b>	Ministry of Construction
<b>MOH</b>	Ministry of Health

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<b>MOLISA</b>	Ministry of Labor, Invalids and Social Affairs
<b>MOSTE</b>	Ministry of Science Technology and Environment
<b>MPI</b>	Ministry of Planning and Investment
<b>NGO</b>	Non Government Organization
<b>NPK</b>	16 % N + 16 % P <sub>2</sub> O <sub>5</sub> + 8 % K <sub>2</sub> O + 13 % S (mineral fertilizer)
<b>NRWSS</b>	National Rural Clean Water Supply and Sanitation Strategy up to Year 2020
<b>OFH</b>	Operating farm household including BGP and connected ML
<b>OM</b>	Organic Material
<b>PC</b>	People's Committee
<b>PE-BGP</b>	Biogas plant made of polyethylene
<b>QN</b>	Questionnaire Number (own survey)
<b>SANSED</b>	Research Project in Cooperation of the Universities of Bonn, Bochum and Can Tho with the title "Closing Nutrient Cycles with hygienically safe substrates of decentralized water management systems in the Mekong-Delta, Vietnam."
<b>SEARAV</b>	Southeast Asian Research Association of Vietnam
<b>SPB</b>	Social Policy Bank (evolved as a sub-section of VBARD especially for the poor households, lending at a subsidized rate of about 0.5 %)
<b>TA</b>	Technical Assistance
<b>UN</b>	United Nations
<b>UNDP</b>	United Nations Development Programme
<b>Urea</b>	CO(NH <sub>2</sub> ) <sub>2</sub> (mineral fertilizer)
<b>USD</b>	US Dollar
<b>VAC</b>	Integrated farming combining crops ( <b>Vuon</b> ), aquaculture ( <b>Ao</b> ), livestock ( <b>Chuong</b> ) into a symbiotic system.
<b>VACB</b>	Integrated farm system including BGP
<b>VBARD</b>	VBARD Vietnam Bank for Agriculture and Rural Development
<b>VLSS</b>	Vietnam Living Standard Survey (1992-93, 1997-98)
<b>VND</b>	Vietnamese Dong (approx. 15,000 VND = 1 USD)
<b>WSP</b>	Water and Sanitation Program for East Asia and the Pacific
<b>WSS</b>	Water Supply and Sanitation
<b>WTO</b>	World Trade Organization



## 1 Introduction

### 1.1 Problem Identification and Research Objectives

Today, about 2.6 billion people, equivalent to 40 per cent of the world's population, lack basic sanitation and more than 1 billion do not have access to safe drinking water. Unfortunately, the average trend is still not going down. One of the principal UN Millennium Development Goals is the objective to reduce by half the proportion of people without access to safe drinking water and in the same ratio who do not have access to basic sanitation until the year 2015 (WHO A. UNICEF 2003).

The object of this investigation, the water management and sanitation situation in rural Viet Nam, poses a growing problem for the region. The comprehensive, methodological problem of developing and introducing innovations that achieve high and sustainable acceptance rates by the target group is still a challenge particularly in the context of implementation of national strategies and development cooperation.

#### **Water and Sanitation Crisis in the Mekong Delta**

The Mekong Delta is characterized by dense river networks and abundant surface water resources, finally in exchange with the South-East Chinese Sea. Due to the dynamic development of Vietnam's industrial and agricultural sector in the last decade of "Doi Moi"<sup>1</sup> as well as because of its growing population, there is increasing evidence of pollution of surface, ground and coastal waters. More than 90 % of the country's poor live in rural areas and this gap in living standard is based considerably on the access to clean water and hygienic sanitation (MARD 2000: 6). According to the "Vietnam Environment Monitor 2003 – Water" clean drinking water is provided to less than 50 % of its rural population. On an average, only 44 % of the households in the country have sanitary latrines, in case of the Mekong Delta the coverage does not reach 20 % (WORLD BANK ET AL. 2003:16f). Thus especially in the Mekong Delta rural water supply and adequate sanitation are a growing challenge. According to the facts, the Government of Viet Nam elaborated the "Action Plan 2000-2005" in the scope of the "National Rural Water Supply & Sanitation Strategy Study" (DANIDA 1999) to sustainably improve situation. This however is likely to take longer to fulfill the projects' objectives.

Based on the policies, implementation of decentralized wastewater treatment systems on operating farm household level that use feces in agricultural production in a hygienic, economic and ecological appropriate way is seen as an effective loop-approach to this water and health crisis. With an interdisciplinary team the SANSED<sup>2</sup>-

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<sup>1</sup> "Doi Moi" means reformation or renewal of politics. The first period started in 1986 and comprises a combination of policy and institutional adaptations associated with liberalization, opening up and reform, principally in order to achieve an economic performance of Viet Nam in recent years. *cp. Chapter 2.4*

<sup>2</sup> SANSED is an abbreviation in German and means "Closing Nutrient Cycles with Hygienically Safe Substrates of Decentralized Water Management Systems in the Mekong-Delta".

Project aims to link water management with integrated agriculture in the Mekong Delta (BLACK 2002: 11f; CLEMENS 2002:1ff). The project's experimental region is set in the Province Can Tho and includes three communities in which the survey is conducted.

### **Acceptance Analysis in the Context of Development Cooperation**

Both, acceptance research and project evaluation of development cooperation, predominantly examine already implemented innovations and/or projects (ex-post analysis). Thus the measures resulting from it can't be incorporated for the prevision and new development of innovations. In the development cooperation the results of ex-post analysis serve the following projects as gained perception. However, in reality these results are barely used and are only partially helpful, since each project possesses a very individual character due to its diverse background conditions. Also, in the pilot phase an evaluation of attitude for possible acceptance behavior is desirable, in order to undertake conceptual measures of new technologies before their introduction (KOLLMANN 1998: 59).

In the scope of projects in development cooperation and humanitarian aid with emphasis on introduction of appropriate technology the term sustainability principally constitutes the elements (GUTTERER 1997: 52f):

- ↪ Participation of target group – adoption and ownership of activities,
- ↪ organizational capacity – independent continuance and development of activities,
- ↪ consequential charges and profitability – long-term cost covering,
- ↪ technical appropriateness – technical and socio-cultural appropriate solutions,
- ↪ and conformity with policies – borne by local and national policies.

In the survey of sustainability of development cooperation projects, in which various European organizations and foundations participated, all of them call for increased attention to the influencing dimensions. However, the assumption continues that target group orientation, assistance for self-help initiatives and participation generates qualitatively higher acceptance rates automatically and thus, sustainable projects (BLISS 2000: 4f; STOCKMANN A. GAEBE 1993: 210f). This faith of development policy is quite comprehensible, but it all too often lacks an in-depth analysis of the factors for acceptance behavior. Even if one can assume that the chance to develop adequate and accepted problem solutions and/or innovations is good if it takes place in a participatory way, it must be clear that it is the acceptance of an innovation, which ascertains their sustainability and not the all-side postulated target group participation (MESSNER 2001: 13f; STOCKMANN A. GAEBE 1993: 211).

### **Study's Objectives in the Scope of SANSED-Project**

The presented study was developed in the context of SANSED-Project. As mentioned above, operating farm households' acceptance behavior represents a key role for sustainable development. Therefore the objective of this study is an analysis

to the attitude and behavior acceptance of several interlinked innovations like biogas plant (BGP), modern latrine (ML) and use of biogas sludge (BGS). This will contribute to the development of a functional, socio-cultural adapted solution in ecological sanitation and biogas technologies of integrated farm management in the Mekong Delta of Viet Nam.<sup>3</sup> For this purpose the attitude and behavior acceptance of BGP as well as attached latrines will be evaluated. Referring to this, particularly the use of human feces in the biogas technology is a major point of interest. Hence, a further question of attitude acceptance for the use of BGS produced by animal and human feces needs to be clarified. The predominant aim is to identify and evaluate determinants for the acceptance of these innovations. Due to the evaluation of different user groups (operating farm households with and without BGP, ML and system user) aspects arise from different stages of the acceptance process at one evaluated time.

This study describes current socio-economic conditions and their significance to the actual use, treatment and behavior concerning garbage and wastewater. Further the results elucidate attitudes and acceptance towards the evaluated innovations and thus allow recommendations which contribute to a sustainable development of optimized farming systems, preventing water pollution and waterborne diseases.

In detail, the study's objectives are as follows:

- ↪ Analysis of the target group under demographic and social aspects to form a respondent's profile based on their social contacts and information transmission in close relation to the farmer's attitude and acceptance behavior to understand the ways of communication as well as for possible recommendations to enhance the degree of acceptance.
- ↪ Analysis of the target group under economic as well as agricultural production aspects, including assessment of the relationship between financial possibilities and the attitudes and acceptance of the evaluated innovations. Hereby the appraisal of credit conditions and experiences is given high importance.
- ↪ Description of the used water resources according to the season and the type of water conditioning on household level.
- ↪ In the context of analyzing garbage disposal, treatment and use, the assessment of the acceptability to use organic material, especially biogas sludge (BGS) out of animal and human feces as fertilizer for agriculture is a key aspect of this study.
- ↪ Description of the political, institutional network on community level including assessments of the political influence on health and sanitary infrastructure as well as on environmental pollution and use of garbage, especially organic material for agriculture.

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<sup>3</sup> A biogas plant (BGP) is equipment that is able to generate biogas and slurry from feces and other organic wastes by anaerobic fermentation (*cp. Chapter 3.3.2*).

- ↪ Basic description and appraisal of the health care situation for assessment of people's hygienic awareness.
- ↪ Basic description and appraisal of the environmental situation for assessment of people's environmental awareness with emphasis on garbage disposal, treatment and use.
- ↪ Assessments of the perceived attributes on BGP, ML and BGS as well as of the subsequent sludge processing by earthworm breeding according to user and non-user groups. Analysis of the user groups with respect to system users to find according determinants for acceptance behavior.
- ↪ Formulation of recommendations to achieve higher rates of acceptance and diffusion in a sustainable manner.

Despite the dynamic process of decision behavior and respectively the decision to accept, the study should contribute to the optimization of an evaluative approach, which is required in practice because of the low time and finance budget, a qualitatively demand meeting approach (DEVERILL 2001: 11f).

## **1.2 Organization of the Study**

The presented study is organized in 6 chapters. Chapter 1 introduces the problems identified, summarizes the background and outlines the main objectives of the research. The second chapter gives a geographical overview of the country Viet Nam, especially of the sub-region "Mekong Delta" as well as a short introduction of the Province Can Tho, where the research sites are located. Furthermore, the reader gets in-depth information about the farmer household in historical and political community development as well as a critical view of the growing social disparities in the market-oriented Viet Nam of Doi Moi. Chapter 3 refers to the actual situation of rural water supply and sanitation, the wastewater management is described, focusing on the national strategy (NRWSS) and the latest development of integrated farm systems, biogas technology and ecological sanitation concepts. Concerning this matter the framework and overall objectives of SANSED-Project are summarized. In Chapter 4 the theoretical background about research of attitude and acceptance of new technology reveals the conceptual basis of this study. In addition, the methodology and design of the empirical study as well as its implementation is explained. The following Chapter 5 presents and discusses the results of the study according to the user-groups in the three selected research sites.

Finally, Chapter 6 summarizes the study's process and findings and offers recommendations for sustainable acceptance of new technology for wastewater management. Either, references for the development and introduction of the analyzed innovations as well as for the methodological procedure that merit further research are stated.



## 2 Water Management Aspects of Viet Nam with Emphasis on the Mekong Delta and its Center Province Can Tho

Asia is in terms of land area and human population the world's largest region. It accounts for approximately 36 % of global runoff water. But due to the dramatically growing population as well as water demand, the water resource management is an increasing task for a sustainable future of this region. Agriculture activities require 86 % of the available fresh water resources, industry 8 % and the domestic use of households sum up only 6 %. In average, 50 % of the Asian population neither has adequate sanitation facilities nor immediate access to water and of those 90 % live in rural areas. Thus, water pollution and water scarcity are key issues for this region (World Bank et al. 2003: 16f; WHO A. UNICEF 2003).

Accordingly, this chapter provides an overview of the geographical conditions of the Socialist Republic of Viet Nam with emphasis on the Mekong Delta and the Province of Can Tho. In this scope the reader receives a description of the recent development of land use and water resources in the Mekong Delta. Based on this background, the current major problem of environmental pollution, especially of the water resources is worked out. Furthermore, historical and political development factors are described with emphasis on the Moi<sup>4</sup> Resettlement and Doi Moi Movement that are important for the analysis of the current operating farm household behavior in its community environment.

### 2.1 The Socialist Republic of Viet Nam – Geographical Background

Located at the eastern part of the Indochina's Peninsula, Viet Nam is, due to its extreme north-south extension, in the center of South East Asia and a tropical country of the northern hemisphere. The country is bounded on its northern side by China, on its western side by Laos and Cambodia, and on its eastern and southern sides by the East Vietnam and South China Sea (*cp. Figure 2-1*). The climatic conditions of the country bear the monsoon characteristics of South East Asia with the predominate North East and South East winds, an average temperature of 24-27 °C and an average annual rainfall of 1,500-2,500 mm going down principally during the rainy season from April to November.

Viet Nam's territory comprises a total landmass of 330,991 km<sup>2</sup>, and it has a population of more than 82 million inhabitants. In these aspects it is similar to the Federal Republic of Germany. The topography of the country is characterized by its great variety. On the one hand nearly three-fourth of its lands is under mountains, hills and high plateaus, carved by a dense network of watercourses. Otherwise, two great delta areas dominate the settlement of the country, the Red River Delta in the

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<sup>4</sup> Moi is the word for ethnic minorities living in the Northern and Central Highlands and has the significance of "the savages" meant abjectly.

North and the Mekong River Delta in the South (CIA 2004: 3ff). Population density in Viet Nam is one of the highest in South East Asia reaching up to 2,500 persons per



**Figure 2-1 : Map of Viet Nam**  
(Source: [www.internationalreports.net](http://www.internationalreports.net))

km<sup>2</sup>. According to statistics, the population increased from 64.4 (1989) to 82.7 million inhabitants in 2004 (CIA 2004: 7). Nowadays, in Viet Nam 80 % of the population lives in the countryside and 75 % of them practice agriculture and forestry.

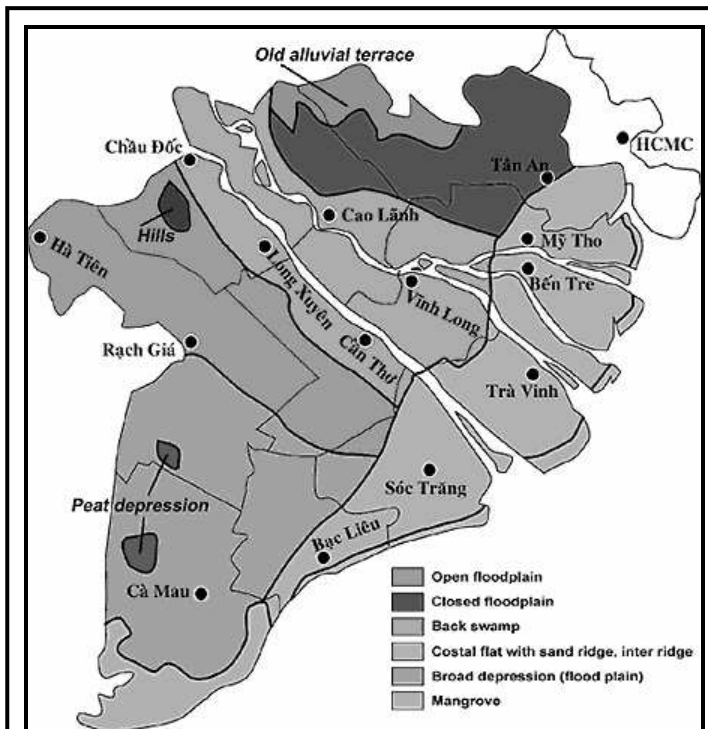
Due to the intensification of agricultural production (*cp. Table 2-2*), 84 % of the total water demand is used for irrigation. The government expects this to increase to almost 90 % by 2010 (WORLD BANK ET AL. 2003: 16). Still, Viet Nam's freshwater and marine biodiversity is relatively high but domestic and industrial water pollution, vial infrastructure development, over-fishing as well as intensive aquaculture hold increasing threats. Assuming an ongoing rapid population growth, the economic and social development will meet with difficulties in particular in dealing with stabilizing and enhancing the living and educational standards

of people. Nowadays 60 % of Viet Nam's population has access to clean drinking water and 44 % to sanitary latrines. Therefore, one of the major issues is water supply and sanitation (NGUYEN 1997a: 2ff). Tackling the water management issues, the Government of Viet Nam (GoV) has raised the public investments in the water sector from 5.7 billion VND in 1996 to 8.6 billion VND in 2001 (WORLD BANK ET AL. 2003: 10f). In order to manage the country's vast water resources in a sustainable way, core issues to be challenged are adopting an integrated river basin approach, adaptation to the water-related vulnerability, improvement of irrigation and domestic water supply services' efficiency as well as reduction of water pollution and its health impacts specifically on the poor (WORLD BANK ET AL. 2003: 12).

## **2.2 Water Resources in the Mekong Delta – Problems and Challenges of a Geographical Hot Spot Area**

The Mekong River origins in the Tibetan Plateau and passes its way on 4,800 km along the country borders of China, Myanmar, Laos, Thailand and Cambodia to split into the "Nine Tailed Dragon" of the Vietnamese Mekong Delta before entering the

South China Sea.<sup>5</sup> On the way through Cambodia the Mekong is joined by the Tonle Sap River, which is the connection to the same named Lake located in a vast depression. This connection is of key importance as its flow reverses twice a year



**Figure 2-2 : Topographical Zones of the Mekong Delta**  
(Source: [www.cantho.cool.ne.jp](http://www.cantho.cool.ne.jp))

(ÖJENDAL 1995: 175f). During the monsoon season the accruing Mekong water body flows into the lake, but as the water subsides, the flow reverses. Thus, the Tonle Sap Lake acts as a natural flood retention basin (ÖJENDAL A. TORELL 1997: 18f). Downstream the Mekong River branches into the Bassac River until they spread into the “Nine Tails” of the Vietnamese Mekong Delta. The Mekong River Delta covers an area of 39,568 km<sup>2</sup> and after experience of many merging and splitting of provinces it now includes 12 provinces. It constitutes one of

the seven agro-ecological regions in Viet Nam. The Mekong Delta region is classified as low plain and has very slight slope from East to West and North to South. Apart from some hills like Mount Sam (270 m) and Mount Co To (258 m) in An Giang and Kien Giang Province next to the Cambodian border, the region has very low landforms with the range of 0-4 m above sea level. Principally the delta’s ecosystem is composed of saline, brackish and freshwater habitats. The main freshwater habitats of the delta include the multitude of rivers and canals, floodplain grasslands, Melaleuca forests and plantations, as well as wet rice fields and other crops (DUONG ET AL. 2001: 123ff). The saline and brackish habitats remain in the coastal and estuarine zones of the delta offering great resources for shrimp farming.

The topography makes the area very vulnerable to flood water from upstream as well as by the semidiurnal tide movement of the South China Sea with its amplitude of 2.5 to 3 meters (NGUYEN, VO-TONG, ET AL. 1998: 18f; NEDECO 1993: 10ff). Otherwise the Mekong Delta’s fertile land is a result of alluvial soils replenished each year by the silt and nutrients deposited by floodwaters (NEDECO 1993: 15f).

<sup>5</sup> In Viet Nam the river is known as Cuu Long, or the “NineTailed Dragon”. According to the number of countries passing through, the river has several names. In China the common name is Lancang Jiang, due to a legend, one of three beautiful daughters of Snow Mountain. The international used Mekong derives from the Thai name Mae Nam Khong, which means “The Mother of Rivers”.

Therefore this delta area has become one of the principal locations for agricultural production in Viet Nam (DUONG ET AL. 2001: 122). From its total area 75 % is agricultural land. For the efficient land reclamation the highly variable water resources of the delta needed to be controlled and regulated. A spreading web of canals has divided and drained the fertile, dynamic ecosystem of wetlands, forests and grasslands. Thus, in the last four decades transitions in society-water relations have dramatically transformed the physical, ecological resources and production systems of the delta.

Principally the extensive, adaptive farming systems suited to the monsoon climate, alternating water levels and local land conditions were transformed to more intensive farming systems reliant on precise water control. Accordingly, the cropping calendar was extended from cropping mainly in the rainy season and with the floods, to cropping also during the dry season dominated by intensive irrigated rice double and triple cropping systems on both, alluvial and acid sulfate soils (NGUYEN 1994: 347ff).

The majority of soils in the Mekong Delta are young alluvium. The intensive agricultural use, their low organic matter content, their low exchange capacities, high acidity (acid sulfate soil) and seasonally saline qualities due to salt water intrusion as well as flooding provoke serious problems (Vo 1997: 10). Soils with high iron sulfide content like the present acid sulfate soils do not usually become a problem as long as the soil remains inundated. Drainage and the following agricultural activities in the acid sulfate soils (Long Xuyen Rectangular) are one of the major causes of water pollution in the region (CHU THAI A. THAI DINH 1994: 232ff; UNDP A. AUSAID 2003: 5).

The area of acid sulfate soils increased to 41 % of the Mekong Delta and constrains the rice production by its nutrient imbalance such as iron toxicity. For this reason it was necessary to intensify rice production by introducing new varieties and changing to double or even triple cropping systems instead of the previous objective to triple the rice cultivated area. Consequently, the water surface area for aquaculture was doubled.

Due to the agricultural expansion and at the simultaneously rapidly growing population of almost 17 million people, this delta is one of Viet Nam's hot spots. With a population density of 420 persons per km<sup>2</sup> it is one of the most densely populated coastal regions of the world (WORLD BANK ET AL. 2003: 58). However, the Mekong Delta is the major food surplus region in Viet Nam, which provides 55 % of total rice production and more than 50 % of total aquaculture production (ÖJENDAL A. TORELL 1997: 24f). *Table 2-1* demonstrates the development of cultivated land and water surface area. Due to the objective of agricultural intensification, especially the cultivated areas for paddy and aquaculture in the Mekong Delta experienced a significant increase in the recent years. At least in the Mekong Delta the production of sugar cane was reduced and upland crops like sweet potato are of minor importance in this region.

Planted area/ water surface in thous. ha	Region	1995	1997	1999	2001	Prel. 2003	total growth in %
paddy	Viet Nam	6.766	7.100	7.654	7.493	7.449	10
	Mekong Delta	3.191	3.481	3.985	3.792	3.786	19
sugar-cane	Viet Nam	225	257	344	291	306	36
	Mekong Delta	98	89	103	76	74	-25
sweet potatoes	Viet Nam	305	267	270	245	220	-28
	Mekong Delta	12	11	11	10	11	-7
aquaculture	Viet Nam	454	504	525	755	858	89
	Mekong Delta	289	327	333	547	615	112

**Table 2-1 : Development of Land Use by Selected Products** (GSO 2004)

According to the dynamic development of planted area and water surface and the simultaneous emphasis on applying intensive cultivation methods, the yields increased significantly. Furthermore, pig breeding was given high priority in the Mekong Delta due to the estimated domestic demand for meat increasing because of the growing population as well as its economic growth. *Table 2-2* demonstrates the enormous development in agricultural production on national and Mekong Delta level.

Yields / Livestock	Region	1995	1997	1999	2001	Prel. 2003	total growth in %
paddy thous. tons	Viet Nam	24.964	27.524	31.394	32.108	34.519	38
	Mekong Delta	12.832	13.850	16.295	15.998	17.524	37
sugar-cane thous. tons	Viet Nam	10.711	11.921	17.760	14.657	16.525	54
	Mekong Delta	5.396	4.428	6.329	4.430	5.103	-5
sweet potatoes quintal /ha	Viet Nam	55	63	65	68	72	31
	Mekong Delta	107	137	117	143	177	66
farmed fish tons	Viet Nam	209.142	279.324	335.979	421.020	573.400	174
	Mekong Delta	119.475	165.591	198.714	248.468	354.826	197
farmed shrimp tons	Viet Nam	55.316	49.298	57.452	154.911	223.792	305
	Mekong Delta	47.121	38.133	41.400	118.432	171.265	263
pigs thous. heads	Viet Nam	16.306	17.636	18.886	21.800	24.879	53
	Mekong Delta	2.377	2.592	2.797	2.946	3.449	45
poultry (mio. heads)	Viet Nam	142	161	179	218	254	79

**Table 2-2 : Development of Agricultural Production by Selected Products**  
(GSO 2004)

Referring to the total growth during the eight years period, especially the production of farmed fish and shrimp with up to 300 % increase reflect the efforts of intensification. Apart from the paddy, also animal husbandry received a considerable development support. The broad network of rivers and canals is used for transportation of the great variety of aqua-, agricultural and industrial products (*cp. Chapter 2-3, Appendix 2-1*). According to the agricultural development, the industrial

sector received a boom, too. *Table 2-3* illustrates the development of industrial output value for Viet Nam, Mekong Delta and Can Tho Province for the domestic as well as foreign invested industry (*cp. Chapter 2-3*). The vast development in industrial production, specifically in the Mekong Delta and herein, Can Tho Province reflects the recent economic history due to the transformation process (Doi Moi) from a socialist oriented central planning government to a progressive opened and market oriented system.

Industrial output value by Sector (At constant 1994 prices)	Region	1995	1997	1999	2001	Prel. 2003	total growth in %
domestic Bill. VND	Viet Nam	77.442	95.542	110.235	147.081	193.774	150
	Mekong Delta	11.293	13.361	14.885	19.208	25.545	126
	Can Tho	1.726	2.355	2.997	4.182	5.724	232
foreign invested Bill. VND	Viet Nam	25.933	38.878	58.515	80.261	109.217	321
	Mekong Delta	944	935	1.561	2.470	3.566	278
	Can Tho	291	241	393	714	743	155

**Table 2-3 : Development of Industrial Output Value by Selected Sectors**  
(GSO 2004)

The Mekong Delta is one of the country's principal regions with abundant water resources, a hot spot in the sense of producing such important economic benefits, but suffering worsened water quality and declined groundwater levels due to the rapid population growth, urbanization and industrialization, intensive agriculture as well as water transport. In recent years the Mekong Delta received a shift from a naturally regulated water regime to an increasingly human regulated system. The requirements for a sustainable use of water resources have been largely ignored to achieve the economic objectives of agricultural and industrial development (MILLER 2002: 11). With the increase of agriculture and industry in the Mekong Delta, the pollution of water sources in the canals and rivers by excrements, wastes and pesticides becomes more serious every day (World Bank et al. 2003: 58f). Furthermore, soil and water pollution, lack of fresh water, soil erosion and negative impact on flora and fauna are increasing due to unsustainable land use in many locations (ÖJENDAL A. TORELL 1997: 143f). As a result the ecosystems have been degraded and the natural resources of the Mekong Delta are not as abundant as before.

In the first instance this development affects the small-scale farm households living in the rural area of the Mekong Delta depending on the natural resources. During the recent poverty assessment conducted by an interdisciplinary team a notable difference between poverty data (e.g. number of poor households) provided by commune and district officers (national statistic) and poverty data coming out from people's self-assessment was recognized. Although livelihoods have improved to remarkable extend in recent years, one of the dominant features of poverty in the

Mekong Delta is more and more poor people are becoming landless (YAMASAKI A. DUONG 2002: 32ff; UNDP A. AUSAID 2003: 22f). The average farm household in Viet Nam owns 0.5 ha and in the Mekong Delta about 1.0 ha agricultural land. According to the data of the Agricultural Census in 1994 *Table 2-4* illustrates the households' distribution by farm size in Viet Nam and the Mekong Delta (MINOT A. GOLETTI 2000: 12f).

Farm size in ha (GSO 1995)	no land	< 0.2	0.2 - 0.5	0.5 - 1.0	1.0 - 3.0	> 3
Viet Nam	1.2	27.0	44.0	16.2	10.5	1.2
<i>Mekong Delta</i>	0.7	6.2	25.7	30.7	32.5	4.4

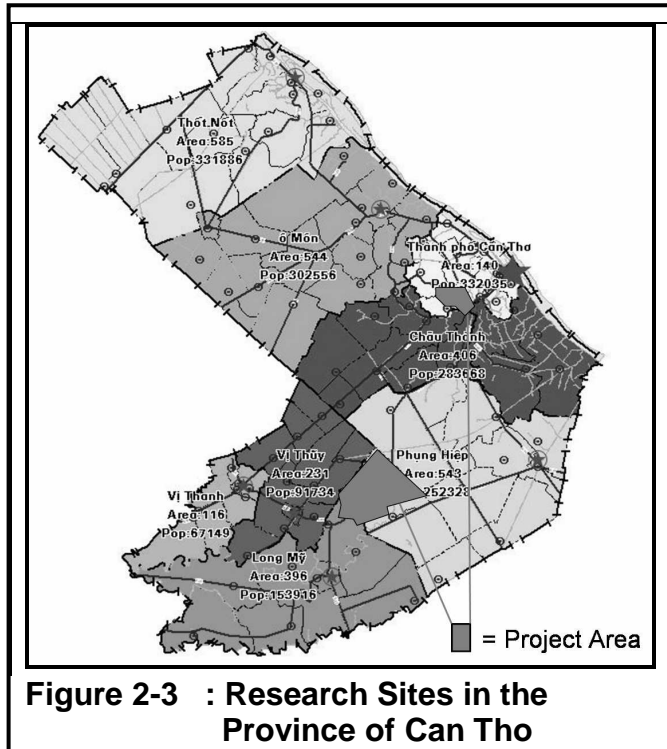
**Table 2-4 : Distribution of Households by Farm Size in Ha** (GSO 1995)

Opportunities for the poor to escape from poverty on a sustainable basis are very scarce. The principle obstacles for poverty reduction are that the majority of poor households are landless or have little land and therefore no access to credits. The development of local enterprises and creation of job opportunities in rural areas has been very slow (UNDP A. AUSAID 2003: 2). The living standard improvement in its majority is achieved by the middle class and wealthy groups. The poor households, especially landless households, households with illness or health problems have become poorer and weaker in their social status. The monthly income per capita by income quintile differs from 126,000 to 860,000 VND (GSO 2004). Driving forces for these changes were the impact of credit programs and the infrastructure upgrade for the whole region and otherwise the decline of free social services and other changes due to privatization and market-oriented politics.

People have the need to use the natural resources, living with the water but not necessarily according to sustainable development concepts. Further the local government still seems not to have the capacity for organization and education to lead to an environmental awareness and according commitments (UNDP A. AUSAID 2003: 4; NGUYEN, NGUYEN ET AL. 1997: 91ff; VO 1997: 25f). The water demand for domestic use accounted only 2 % in 1990 but is expected to triple to 6 % by 2010. Clean drinking water is provided to less than 50 % of the Mekong Delta's rural population. In average only 20 % of the Mekong Delta's households have sanitary latrines (WORLD BANK, DANIDA ET AL. 2003: 16f, 58). According to this water crisis, health costs from waterborne diseases are going to raise in addition to the increase of water treatment costs. The conduction of a strategy for clean water supply and sanitation (NRWSS) may lead to awareness increase, higher investments in required infrastructure as well as the behavioral change of the population in the long-run.

## 2.3 Province Can Tho<sup>6</sup> - Center of Development

The province is divided into seven administrative units comprised of the City Can Tho and six districts that are in turn divided into six towns, 15 urban sub-districts, and 74 communes (AHMED, UMALI ET AL. 1999: 8f)<sup>7</sup>. *Figure 2-3* shows the area of Province Can Tho with the location of the research communities An Binh, Long Tuyen and Hoa An (*cp. Appendix 2-2*).



**Figure 2-3 : Research Sites in the Province of Can Tho**

Figure 2-3 shows the area of Province Can Tho with the location of the research communities An Binh, Long Tuyen and Hoa An (*cp. Appendix 2-2*). The average population density reaches over 600 persons per km<sup>2</sup>. It covers almost 3,000 km<sup>2</sup>, of which 2,500 km<sup>2</sup> are suitable for agriculture use. The entire area is flat with an elevation of 1 meter above sea level. The tropical monsoon climate is characterized by a rainy season, lasting from May till November with south-westerly winds. During the dry season from December to April north-easterly winds dominate. The basic climate data are constituted by an average temperature of 27 °C, average rainfall of 1,635 mm

per year, an average of 2,582 hours of total sunshine/year and an average annual humidity of 83 % (LE, POMEROY ET AL. 1996: 3f).

As Capital of the Province, Can Tho City with its 210,000 inhabitants has been recognized as the center of economy, culture, science and service in the Mekong Delta. Further, it is home to a University (CTU), which is one of Vietnam's most important agricultural research institutions. The splitting of Can Tho Province into Can Tho Municipality and Hau Giang Province implicates its importance as development center for agriculture as well as the up-coming industry.

Located in the heart of the Mekong Delta and to the West of Hau River, Can Tho Province borders on 6 provinces (*cp. Figure 2-4*). The Hau River is one of the principal Mekong River arms with an average total flow of  $255,000 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$  ( $8,100 \text{ m}^3 \text{ sec}^{-1}$ ) and 8 to 12 meter mean water depth in the upper estuary depending on the season.

<sup>6</sup> On 25th November 2003 it was decided to split Can Tho Province into Can Tho Municipality and Hau Giang Province. As the administrative change is still in process as well as data availability, here the former Can Tho Province is described.

<sup>7</sup> Authorized source: Yamashita (2004), Department of Environment and Natural Resources Management, Can Tho University, Vietnam / On-line Project AMEDER - Assistance for the Mekong Delta Researches, Viet Nam - [http://cantho.cool.ne.jp/index\\_e.html](http://cantho.cool.ne.jp/index_e.html)



Thus, Can Tho's river port is suitable for 10,000-tonne ships (THU 2000: 3). The



**Figure 2-4 : Mekong Delta and Location of Can Tho (www.can-tho.com)**

province' excellent land and waterway systems are favorable conditions for cultural and economic exchanges with Ho Chi Minh City, other provinces, Cambodia as well with overseas countries. Therefore it is the center of industrial development in the Mekong Delta (cp. Table 2-3). From this point of view, the approved master-plan until the year 2010 supports the establishment of three industrial parks in Can Tho. Priority is given to the development of manufacturing industries for agricultural products (fruit juice, dried and canned food, etc.), export commodities like

shoes, textiles, electronic equipment and the chemical industry (fertilizer, pesticides and pharmaceuticals).

According to the recent development of agricultural production in the Mekong Delta, Table 2-5 gives an overview for the Province Can Tho respectively.

Cultivation / Product		1995	1997	1999	2001	Prel. 2003	total growth in %
Planted area / water surface	paddy (thous. ha)	402	389	467	441	453	13
	sugar-cane (thous. ha)	29	22	26	15	17	-42
	aquaculture (thous. ha)	8	11	12	14	17	109
Yields / Livestock	paddy (thous. tons)	1.711	1.713	1.980	1.954	2.145	25
	sugar-cane (thous. tons)	1.800	1.483	1.789	1.088	1.227	-32
	farmed fish (tons)	6.263	7.493	11.342	15.057	41.405	561
	pigs (thous. heads)	206	220	243	289	315	53

**Table 2-5 : Agricultural Development in Can Tho Province (GSO 2004)**

The tendency of expanded cultivated land and water surface area as well as of the increasing yields and livestock are very similar. With regard to aquaculture, especially the yield of farmed fish has increased as Can Tho is located in the center of the Mekong Delta. Generally, Can Tho is a region dominated by agro-fishery

production on small-scale farms with 0.5 to 2 ha. About 80 % of its 1.9 million inhabitants live in rural areas and thus, almost the same amount dedicates their labor to agri- and aquaculture. On three quarters of the agricultural used land rice is cultivated with up to three crops per year, depending on the soil quality. The annual yield accounts more than 2 million tons of rice and is going to be increased. Further, the data indicate a significant development of pig production. This is based on the fact that in the Mekong Delta animal husbandry concentrates mainly on pig breeding with the Province Can Tho ranking first place and second place in poultry. In the areas which are less flood prone, fruit growing is practiced. Although Can Tho is not the principal province for fruit growing, the Mekong Delta is covered by 300,000 ha of orchards producing 4 million tones per year, which is important for the up-coming industry for agricultural products in Can Tho City (GSO: 2004). Upland-crops (cassava, sweet potato, vegetables) are cultivated to a limited extent in this region.

#### **2.4 Moi Resettlement and Doi Moi Movement – Impacts on the Vietnamese Farm Household’s Standing in the Village Community**

The importance of the village community in Viet Nam reaches back to the genesis of the nation. In their communities the insurgencies and liberation activities started already against the Chinese oppression and continued repeatedly until the mobilization of the National Front for Liberalization of Viet Nam (FNL) to overthrow the Diem-Dictatorship (1955-63). The peasants were sent in the movement southward (nam tien) to cultivate land and to rebuild for the state. The village communities did the base work to colonize the South. In the 15<sup>th</sup> century the so-called “don dien”, military colonies constituted of ostracized, landless people, were driven to reclaim land as peasant soldiers and to conquest Cham and Khmer territories. The village communities developed as states within the state, the traditional Viet Nam was seen as federation of village communities. Hereunto rely proverbs like “The law of the king gives way to the village’s tradition.” or “The village has its laws like the state has.” However, the French colonization destroyed the traditional, well-functioned balance of “village-state” and state and left behind communities without social substance. The communist era recognized this social disruption and reorganized farmer communities tied to the revolutionary People’s Committee (PC). This step is seen as the most important one for the fortification of community life and the social development of the Socialist Republic of Viet Nam. In this context the country’s socialization by the term “xa hoi hoa” suggests the reestablishment and fulfillment of traditional values that had been weakened by the French Governance (WILDGRUBER 1979: 36ff).<sup>8</sup> This brief overview of community

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<sup>8</sup> “Xa” means village, composed by Chinese signs “thi” for “spirit” and “tho” for earth, soil and thus, represents the location where rice farmers come together to revere the village spirit of protection (Wildgruber 1979: 43).

history shows on the one hand the roots and significance of social community life and on the other hand interventions of its disruption.

Nowadays the Socialist Republic of Viet Nam still counts more than 60 nationalities. The ethnic Vietnamese (Kinh) constitute about 84 % of the population, while Chinese (Hoa), Tay, Khmer, Thai, Muong, Nung, Meo, Dao, Giarai and Ede compose the biggest minority groups with more than 100.000 persons each (BURO A. GROBE 1984: 147ff). In the concepts of various five-year-plans since 1961 it was aimed to resettle up to 10 million people. The regions which were most effected are the Northern and Central Highlands as well as the Mekong Delta. The governmental objective of minority politics was to overcome ethnic regional distinctions and prejudices (BURO A. GROBE 1984: 154f). The approach and treatment of the minorities has a long and difficult history that did not come to an appropriate solution even today.

However, the minority politics hold important issues for community life in Viet Nam and especially for the Mekong Delta, which was one of the principal settlement areas. The reclaim of land by digging canals in the Mekong Delta, especially under the French Governance, was driven forward (NGUYEN, VO-TONG ET AL. 1998: 31ff). The canals dramatically changed the shape of the delta as they drained off the excess surface water from the depressions and decreased the period of flooding from 12 to less than 6 months (HANHART A. DUONG 1993: 161ff).

Further, the canals served as major routes for settlement and the subsequent agriculture activities. Although Viet Nam was at war for three decades and suffered heavy casualties, the rural population has increased rapidly in the last seven decades. In the Mekong Delta the population increased by 2.2 per cent/year from 3.2 million (1930) to 11.8 million (1990) and up to almost 18 million inhabitants today (DAO 1995: 152f). Reasons are both, natural reproduction and high net migration rates (resettlement/employment pull factor). Until today families, especially landless farmers are settled in the Mekong Delta.

Collectivization was introduced lately in South Viet Nam in 1978 and with little success compared to other regions of the country (DAO 1995: 153f; NGUYEN, VO-TONG ET AL. 1998: 47). Furthermore, the de-collectivization already began in 1981, lasting until 1988, when the period of Doi Moi was in its first steps. Thus, in 1981 the Government started to reconstitute the farm households as the major unit of agricultural production in place of the farm cooperative but initially under a special contract system (DAO 1995: 139f). Thus, the farm household's position, responsibilities and opportunities in decision making, were the subject of several great changes.

In the mid-1980s Viet Nam was despite the Soviet Union's aid (10 % of GNP/year) one of the world's poorest countries. This aid was phased out and finished in zero due to the CMEA<sup>9</sup> breakdown (TROGEMANN 1997:1; WEGGEL 1999: 15ff).

The Vietnamese expression "Doi Moi" translated means reformation or renewal of politics. The first period started in 1986, when Viet Nam began to implement the first measures to shift from a centralized, planned economy, typical for a communist-socialist republic, into a market oriented system (NGUYEN A. FRIEDERICH 1997: 25f; WOLZ 2002: 11ff). In 1988 the Vietnamese Government published its tenth resolution on reform for economy and management of agriculture. It was the milestone for a more market oriented agriculture and increasing rights and independence for the farmers (YOSHIHARA A. NGUYEN 1998: 290f). According to the Land Law approved in 1993, the farm household is really recognized as the main unit of agricultural production. It grants farmers a 20-year right to land used for annual crops and a 50-year land right for perennial crops. Furthermore, it liberalizes the farm's decision-making related to the purchase of in- and output. Finally, most important for acceptance and investment are the established rights of transfer, exchange, lease, inheritance and mortgage (BARKER 1994: 39ff; UNVN 1999: 71f). These reform measures resulted in an immediate growth in agriculture production. Already in 1992 the five agricultural products rice, coffee, peanuts, fruits and vegetables were amongst Viet Nam's top ten export commodities. Further, the land law has undoubtedly an impact on income opportunities, creditworthiness, labor distribution and social differentiations due to the development of a land market (DAO 1995: 157f; MAERTENS 2004: 9f).

In the period from 1992 until 2000 the efforts at reducing poverty (households with a monthly income of less than 150,000 VND, approx. 10 US\$) resulted in bringing down the number from 70 % down to 30 % of the population (WEGGEL 2001: 595f). Due to the fast-paced economic development including membership in the ASEAN and recent conclusion of the bilateral EU-Vietnam agreement for Vietnam's accession to the WTO, the country gained increasing attraction for international investment. Nevertheless, this development is emphasized on urban population, creating an even bigger difference in living standard to the rural area and with every step forward of this movement it seems that the inequality between urban and rural Viet Nam grows. The health care system has been privatized and the health credit

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9 CMEA means Council for Mutual Economic Assistance (also COMECON or MEA). The stated purpose of the organization was to enable member states to exchange economic experiences, extend technical aid to one another, and to render mutual assistance with respect to raw materials, foodstuffs, machines, equipment, etc. The council started with the Soviet Union, Albania, Bulgaria, East Germany, Czechoslovakia, Hungary, Mongolia, Poland, Romania, and expanded its membership to include Cuba (1972) and Vietnam (1978). It was disbanded in June 1991, when democratization, the collapse of trade and conversion to hard currencies rendered it redundant.

cards for poor households to receive free treatment are not working out, especially in the urban area (UNDP A. AusAID 2003: 2f).

Thus, the Vietnamese style perestroika does not seem to go deep enough. Especially the poor people in Viet Nam need the continuance with socialist economic principles and reforms that are creatively adapted to reality and open for future modifications as required by globalization. But in the last years it looks like Viet Nam is on the way to become a kind of hybrid with capitalism in fact and socialism in name only (KOLKO 1997: 159). The informal market is growing every year and it is based principally on plagiarism market, fed by its big brother China. It is questionable if this manner of development is sustainable.

As in other countries, the logic of communist authoritarianism destroys its socialist ideals and paralyzes the reform progress. To get out of the so-called reform immobility and to achieve a social Doi Moi revival, it is necessary to reduce the overwhelming influence of governmental and communist party factions (DIEHL 2002: 288ff). The balance to develop and enhance the privatization process and at the same time not to loose the socialist path, is the opportunity and challenge of Viet Nam's today and in the future.

Recapitulating, in this time of great changes it is difficult for the farm households to orientate, especially those that live in poor conditions having bad access to information. The two major aspects of Moi resettlement and Doi Moi movement entail that especially the Mekong Delta area does not count on a historically grown, tight community life which is based on few extended tribal families with solid social relationships. But rather kept there individuality and independence, supplemented of an mercantile thinking due to the high percentage of Chinese ancestors, that was even supported by the de-collectivization process, the new land law and further structural and economic reforms in agriculture production.

### **3 Wastewater Management – Policies, Research and Implementation in Viet Nam**

According to the geographical background and the development of land and water resources use in the Mekong Delta region, the major environmental problems specifically related to water management have been depicted. Hence, in this chapter the status quo of wastewater management issue with emphasis on its recent development in Viet Nam is described. This includes explanations of the focused innovations of biogas technology, sanitary latrines and the reuse of excrements in integrated farming systems. Subsequently, the main aspects and objectives of SANSED-Project, which aim at an improvement of these conditions, are summarized to conclude the framework for this study.

#### **3.1 Wastewater Reuse in Agriculture – Water Management, Environment and Human Health Aspects**

In the developing world the growing population faces a broad range of problems in providing water supply, organic and inorganic waste management and food security. About 60 % of urban wastewater (rural wastewater even more) worldwide doesn't receive treatment at all (HOEK 2001: 4). In most cases wastewater is discharged directly into surface water resources, following canals and rivers to the coastline. For industrialized countries sustainable wastewater treatment is still a challenge, so the general lack of capital, infrastructure and the widespread phenomena of political unsteadiness make it appear as an impossible task sometimes.

An alternative to the disposal of untreated wastewater is to reuse the water and its nutrients for agriculture combining biogas technology and ecological sanitation in integrated farm systems (WINBLAD A. SIMPSON-HÉRBERT 2004: 71ff; CRITES A. TCHOBANOGLOU 1998: 971ff). Accordingly wastewater may be seen as valuable resource providing an opportunity to increase agricultural production and improve food security in a sustainable way, reducing environmental pollution and health risks at the same time (*cp. Chapter 3.3*).

The following principle advantages and disadvantages to reuse wastewater in agriculture can be summarized (Hoek 2001: 4):

##### Advantages

- ↪ Water conservation by recycling and groundwater recharge.
- ↪ Low-cost method for sanitary disposal of wastewater.
- ↪ Reduction of surface water pollution.
- ↪ Substitution of mineral fertilizer to increase crop yields.
- ↪ Provision of reliable water supply for farmers.

### Disadvantages

- ↪ Health risks for agricultural producers and consumers in case of using untreated wastewater for irrigation.
- ↪ Contamination of groundwater with nitrates.
- ↪ Buildup of chemical pollutants/heavy metals in the soil.
- ↪ Creation of habitats for disease vectors such as mosquitoes, etc.

The task is to benefit from the multiple advantages by avoiding the supposed risks of use. Especially the potential risks on human health have always been the main concern when referring to wastewater reuse and that has hampered a progressive development of its usage.

However, water scarcity and population increase accompanied by severe sanitation problems claim for more efforts to reduce the level of wastewater pollution.

## **3.2 The National Program for Rural Clean Water Supply and Sanitation Up to the Year 2020**

In Viet Nam, due to industrialization and modernization, access to clean water and hygienic safe sanitation are basic needs of people's daily life and they have become urgent requirements for protection and improvement of people's health and living conditions; waterborne diseases such as diarrhea, intestinal worms and intestinal diseases are very common. As result of these circumstances a strategy which provides a long term and overall framework for rural water supply and sanitation development is needed. Thus, the "National Rural Clean Water Supply and Sanitation Strategy" (NRWSS) was approved by the Prime Minister in 2000 (Decision No. 104/2000/ QD – TTg dated 25<sup>th</sup> August 2000).

### ***3.2.1 The National Rural Water Supply and Sanitation Strategy - Main Aspects***

The National Rural Water Supply and Sanitation Strategy (NRWSS) is a long-term strategy that is still in its development process. It focuses mainly on the supply of clean water for domestic use and on sanitation needs of households.

### **Identification of Problems and Research Demand for the Mekong Delta**

In the Mekong Delta low topography, flooding, salinity, relatively fragile and easily polluted deep ground water resources are the main concerns. Particular emphasis should be placed on appropriate and sustainable technical solutions to replace fishpond latrines, which are causing sanitation problems and environmental pollution in this flood prone area with about 17 million inhabitants (MARD a. MOC 2000: 42).

Fishpond latrines have been the traditional solution in the South but due to the ban on the use of such latrines MOH should coordinate with MARD and MOSTE to carry out studies on appropriate solution.

In Vietnam double vault composting latrines (DVC) have been used for a long time however at present, there are still different opinions concerning this type of latrine. Therefore assessments of their use have to be realized to make this type of latrines reach hygienic standards.

In this context the reuse of human excreta as fertilizer has economic implications for many farmers in agricultural production. That makes it impossible to ban the use of human excreta as fertilizer. Solutions have to be found to use human feces in an environmental and hygienically safe way. Furthermore, official regulations on standards of composted human excreta, process of composting, and a strict ban on the reuse of fresh (non-composted) human excreta are indispensable (MARD A. MOC 2000: 38).

### **Formulation of NRWSS Objectives**

The strategy is an overall framework including the general guidelines about how to achieve its objectives until the year 2020 (MARD A. MOC 2000: 1ff). The key objectives of the strategy can be summarized as follows (MARD A. MOC 2000: 11ff):

- ↪ To improve health of rural population by improving water supply, latrines and promote hygienic practices of people.
- ↪ To improve living conditions to reduce the disparities between rural and urban population.
- ↪ To reduce environmental pollution by disposal of untreated human and livestock excreta in open water resources to a minimum.

#### **Objectives to achieve until the year 2005:**

- ↪ To provide enough clean water and hygienic latrines for all kindergartens, schools, and other education institutions as well as hospitals, offices and markets in the rural area.
- ↪ To control the domestic farming, collective farming, and production in rural villages in order to keep the environment clean.
- ↪ To prevent exhaustion, pollution of underground water, surface water in pools, rivers, springs in order to preserve its quality (MARD A. MOC 2000: 43ff).

#### **Objectives to achieve until the year 2010:**

- ↪ 85 % of rural households will have access to at least 60 liter/day of clean water in line with the national standard and 70 % have access to hygienic latrines and exercise sustainable hygiene practices.

Until the year 2020 all rural households are supposed to have access to these water supply and sanitation facilities and keep the hygienic practices.



### **3.2.2 Approach to Implement the NRWSS**

The general approach of the strategy is demand responsive and sustainable. This means that all planning and implementation shall give priority to sustainability rather than to other factors such as speed of implementation.

In order to apply the demand responsive approach and to achieve sustainable development, five implementation guidelines need to be followed (MARD A. MOC 2000: 13ff).

- ↪ Selection of technology is done by the user and the governmental agencies facilitate the service and operational arrangements.
- ↪ Due to the principle of ownership, the users have to pay the investment and running costs. Only poor households receive governmental support. Special technologies will be promoted officially.
- ↪ In the scope of IEC programmes people will be guided and trained in all aspects (technologies, operation financial mechanism)
- ↪ Shared RWSS facilities (for example full piped water supply schemes) have priority for implementation.
- ↪ Advanced and appropriate technologies will be promoted.

However, in order to also reach the poor people, social policy target households and those who live in areas with extreme difficulties the Government will have grants to assist them in construction of WSS facilities. The banks will administer funds and users will have to form self-help-groups or cooperatives to apply for credit or grant (MARD A. MOC 2000: 27ff).

The implementation of NRWSS started in 2001 with a study of 15 provinces during the first 2 years and to expand the models up to 46 provinces. These provinces may represent the country's variety of different areas. Further, international cooperation is utilized in terms of technical assistance, financial support and international experiences of rural water supply and sanitation. By means of IEC activities organization and management capacity are going to be strengthened at all institutional and administrative levels. Therefore the base is created by drafting and promulgation of legislative documents and the human resource development for the RWSS-sector. To guarantee an efficient monitoring and evaluation, the establishment of common database for RWSS is indispensable (MARD A. MOC 2000: 43ff).

### **3.2.3 First Animadversion and Recommendations on NRWSS**

The implementation of the NRWSS started in 2000 to introduce new strategies and principles for achieving objective set for rural water supply and sanitation in Vietnam.

Thus, higher priority has been given to support rural water supply and sanitation by national and local authorities in recent years.

During the National Workshop on Rural Water Supply and Sanitation in Hanoi March (2003) a position paper was elaborated. This review of the NRWSS implementation by the involved institutions and donors point out that people will demand efficient systems for the lowest cost, but up to now NRWSS doesn't allow them to make clear choices based on design or cost feasibility. Rainwater collection for domestic use is discouraged, although it can be promoted cheaply, efficiently and hygienically (MARD 2004: 2f). Further, it was frequently observed that systems are over-designed, very hygienic and safe latrines, filter systems, which are not appropriate to conditions and needs. As a result large numbers of abandoned or destroyed equipment was found because of models and techniques that are not appropriate to the local environment or culture. May be the planning procedure was conducted in a participatory way, but looks like this did not lead to the necessary acceptance behavior (MARD 2004: 3). Consequently, the following recommendations on NRWSS have been elaborated very recently:

- ↪ Provision of subsidies to remote rural areas
- ↪ Emphasizing appropriate technology based on real participation
- ↪ Practical standardization of terminology definitions (e.g. clean water)
- ↪ Improvement of communication to province, district, and commune
- ↪ Promoting behavioral change in hygiene rather than solely hygienic latrines
- ↪ Encouraging more participation in IEC
- ↪ Efficient monitoring of behavioral change

### **3.3 Opportunities and Solutions for Wastewater Reuse in Viet Nam - Integrated Farm Systems, Biogas Technology and Ecological Sanitation**

Three research fields seem to develop more or less independently encountering difficulties in efficiency, acceptance and diffusion. Using synergetic effects of these fields to achieve sustainable success in the issue of Viet Nam's water crisis might be a promising approach and is therefore followed by the SANSED Project (*cp. Chapter 3.4*). In this chapter the three working fields of integrated farm systems, biogas technology and ecological sanitation are described keeping in mind the study's objective to analyze attitude and acceptance of the interlinked innovations BGP, ML and BGS in integrated farm systems.

### **3.3.1 The Development of Integrated Farm Systems for Wastewater Reuse in Agriculture**

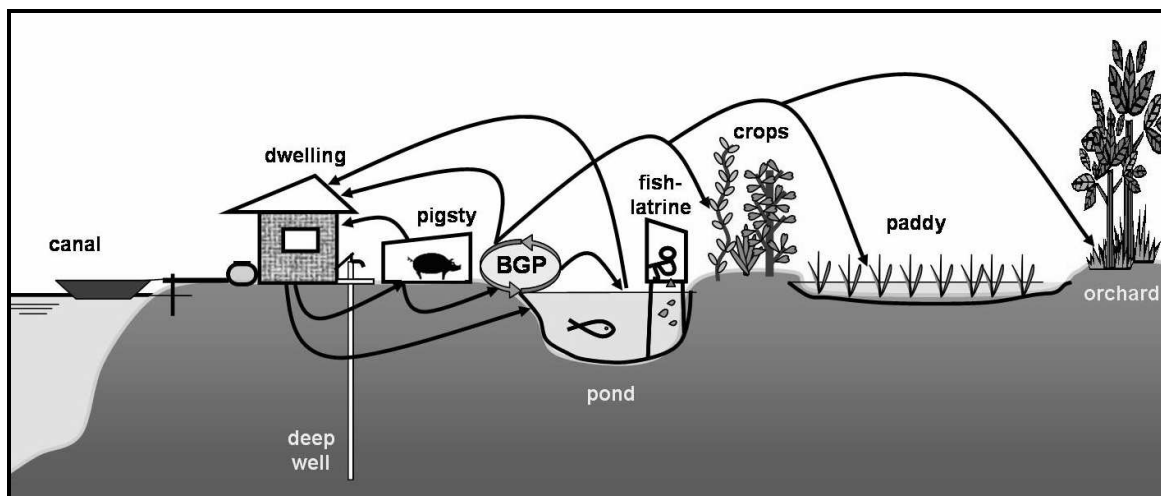
In 1992 the “National Plan for Environment and Sustainable Development: A Framework for Action” was approved. Its objective is to develop and implement a comprehensive framework for national and sub-national environmental planning (Vo 1997: 24f). Consequently in 1993, the National Assembly of the Socialist Republic of Viet Nam passed the Law on Environmental Protection. Hence, the political and legal framework has been built up. Beyond seven identified action programs are the integrated watershed management and the pollution control and waste management. Nevertheless, the real problem is the introduction and implementation of environmental technology that is still poor and in many cases requires high investments. In the scope of poverty reduction measures it was necessary to restructure the agricultural production system, introducing new technology in cultivation practices as well as machines and installations. This movement was the base for an enforced development of integrated farming systems. They offer unique opportunities for maintaining and extending biodiversity with the emphasis on optimization of resource utilization (RODRIGUEZ, PRESTON ET AL. 1998: 15).

Due to the fact that the Mekong Delta is an important pig-producing region, the water pollution problems by pig waste disposal in open water resources have been very present. In the 90s, on base of the traditional Asian small-scale farming, integrated farm systems (VAC) and later on biogas plants were introduced and promoted as an appropriate solution to this environmental problem (DELMENDO 1986: 1f; YOSHIHARA A. NGUYEN 1998: 289ff). Thus, an agricultural extension service as subsection of the farmer union (one of the mass organizations; *cp. Figure 5-36*) was built up to disseminate information and to assist this reform process. The extension service is one of the major channels to transfer new technology to farmers in the Mekong Delta (LE, YAMADA ET AL. 2002: 103). The overall objective is to establish a network of technicians, demonstration plots and to conduct training courses. Agents for information and marketing should facilitate farmers’ concerns in technical development and market access (Nguyen, Yamada et al. 2002: 365ff).

The VAC farming system is the basic model, meanwhile widely recognized in the Mekong Delta. It integrates crops (**Vuon**), aquaculture (**Ao**) as well as pigs and sometimes other livestock (**Chuong**) into a symbiotic system that reduces the dependence on external inputs, while increasing productivity (KOSSMANN A. PÖNITZ 1999a: 48f). The output from one sub-system (e.g. feces from pigs/poultry) becomes the direct input for another sub-system (e.g. feed for fish or organic material for plant production). Summarized, residues of animal husbandry serve for plant production and vice versa.

Although this system is a sophisticated but practical approach to close the substrate loop, it does not provide a proper treatment of animal waste. Hence, it was enlarged

by BGP as treatment module for animal waste to the VACB farming system (*cp. Figure 3-1*). Feces are collected in a BGP, the slurry accumulates in the plant and due to the input amount it is emptied. The sludge can be dried or composted and used as organic fertilizer. In some cases, the effluent of the BGP can be directed into the fishpond to use the nutrients of the effluent for aquaculture during the whole time of operation. The biogas is used for cooking and to sterilize water by boiling. Since the mid 90s these integrated farming systems have attracted high attention of researchers and took a couple of modifications (VACR (**R**ice), VR) which are still in the investigation process (KOSSMANN A. PÖNITZ 1999a: 48f; YAMADA A. OHISHI 2003: 411f).



**Figure 3-1 : VACB - Integrated Farming System with BGP and Principle Substrate Fluxes** (Source: modified acc. LE ANH TUAN 2003)

Nevertheless, the dissemination of BGP in the Mekong Delta declines and in the VACB system, the sanitary issue is not solved (DUONG A. LE 2002: 3). Consequently it is to investigate for an optimization of the VACB system and to look for possibilities to include an appropriate sanitation solution accepted by the population.

### **3.3.2 Biogas Technology in Viet Nam – Renewable Energy and Opportunity for Wastewater Reuse in Agriculture**

Biogas is a cheap energy resource and is composed of methane (60-70 %), carbon dioxide (30-35 %) and other gases. The major objective is the replacement of firewood and coal for cooking purpose, substituting oil and electricity for lighting and even to be used instead of gasoline for running machines and motors. A biogas plant (BGP) is equipment that produces biogas and slurry from feces and other organic wastes by anaerobic fermentation (KOSSMANN A. PÖNITZ 1999: 4ff). The biogas is a regenerative energy source, burns odorless and with little release of sooty particles. In addition, the advantageous attribute to improve hygienic conditions by elimination of pathogens during the fermentation process is important but often underestimated (GUTTERER 1997: 40). Since the beginning of the “biogas-age” in the 70ies a broad

range of models have been developed all over the world. Biogas technology was the prime example of the “Appropriate Technology Movement” (GUTTERER 1997: 31f). Appropriate technology is defined as an optimized technology concerning socio-cultural, economical and environmental aspects, which can sustainably be implemented to solve certain problems in developing countries under their individual, local conditions (ERBEL 1998: 177). For the selection and development of appropriate technologies for water supply and sanitation counts especially the consideration of socio-cultural aspects. This is more important for sustainable development than the selection of a certain (very sophisticated) technique (ERBEL 1998: 179). Consulting and training in technical and socio-cultural (health education) as well as environmental related aspects are important for a continuous behavior change in water use and sanitation. Of course cost covering and profitability are inevitable requirements. Further, the availability of locally produced construction material and spare parts to avoid dependency on import is of great advantage (HEGEMANN 1998: 193f). That is the theoretical knowledge gained after decades of implementation.

The big break through was located in China. In the 70s biogas technology was agreed to be the major force for the development of Chinese energy resources and was supposed to accelerate the progress in agriculture production. Until 1978 more than 7 million biogas plants had been constructed, most of them in the region of Sichuan. But only a few years later over 80% of the installations broke down (BUI 2002: 2; GUTTERER 1997: 62). Deficiencies in construction, poor performance and back up service as well as missing cost covering and training for maintenance beyond other constraint lead to disappointment and bad reputation. A period of adjustment followed, but in many countries could hardly regain the image. In the end, principally China and India are the countries that could affront the setback in the long run.

However, the reason for China, especially the Chengdu-plain, being the heart of BGP development were the agricultural cultivation methods practiced in this region.<sup>10</sup> The cultivation of paddy, low mechanization level, intensive piggery and the tradition to use feces as fertilizer were optimal conditions to introduce biogas technology.

These conditions are similar to those in the Mekong Delta of Viet Nam. Here, the introduction of BGP began slowly about 20 years ago. In former times the major motivation was to alleviate the problem of energy shortage in rural households. The poor acceptability based on high investment costs, difficulties in installing and maintenance as well as problematic access of spare parts similar to other regions of the world. As a conclusion it was aimed to develop a BGP model that solves these problems (BUI 2002: 4). In 1992 a project funded by Sida/SAREC and FAO studied strategies for sustainable use of local resources in livestock-based farming systems.

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10 In the Province of Sichuan in Southeast China, the hydraulic engineering project “Dujiangyan” enabled the agricultural land use of the Chengdu-plain 2,200 years ago.

That was the scope, polyethylene tube BGP were introduced in integrated farming systems (VACB). Hence, in Viet Nam it can be principally distinguished between BGP made by bricks and concrete (CC-BGP) and BGP using a plastic (polyethylene) tube for storage of feces and gas (PE-BGP) (*cp Chapter 5.8; Appendix 3-1*). The latter is much cheaper, easier to operate and flexible in its location. In order to simplify the operation the PE-BGP is used with a continuous flow of water and substrates that produces effluent with each new input. The low cost, family size PE-BGP of 6-10 m<sup>3</sup> is available for 500-1,500,000 VND (35-100 US\$) (DUONG A. LE 2002: 5). Thus, it is in many cases more accessible for small households than the more expensive CC-BGP (according to size, 150 to 500 US\$ and even more). Accordingly, bigger farms or small companies may prefer the CC-BGP.

Within the BGP-project 40 provinces in Viet Nam as well as some locations in Cambodia, Lao, Thailand and the Philippines have been included. In Viet Nam more than 20,000 PE-BGP have been installed since the beginning of introduction and most of them in the eastern area around Ho Chi Minh City. Several private units, NGO's and governmental institutions were involved, but mainly in the South as in the North the Agriculture and Forestry Extension Department of MARD didn't stimulate the development of BGP (BUI 2002: 5). The introduction of the BGP was primarily based on pig production. Contrary to other countries, in Viet Nam about 90 % of BGP are supplied with pig manure as they were introduced, apart from the energy aspect, with the major aims to prevent odour annoyance and water pollution by uncontrolled discharge of piggery wastewater in open water resources. Partly, local governments for these reasons imposed installations.

But although the Mekong Delta is an area with intensive piggery the number of installed BGP reached only 27 % in 1999, 15 % in 2000 in comparison to the South-Eastern area of Viet Nam with further declining tendency (DUONG A. LE 2002: 4). Since the decline of dissemination many studies have been conducted to find the bottleneck in technical and operational aspects improving the efficiency of BGP operation technology and optimizing the utilization of effluent as organic fertilizer. Also the construction costs varied due to using different materials and change of design (VO, WATANABE ET AL. 2002: 275ff). The optimization process is not finish yet. BUI (2002: 5) states that one of the major constraints for poor farmers is lack of capital to invest in raising animals to get manure. Conversely, it is possible that the intention to introduce BGP and therefore its dissemination is too slanted toward the input of animal manure. Would it make sense to convince farmers to change their production to animal husbandry in order to become a potential biogas producer and user? Is that the way to achieve acceptance to invest and use BGP?

However, BUI (2002: 7f), DUONG AND LE (2002: 6) as well as BUI, PRESTON ET AL. (1997: 8) explicitly state the necessity for research on technical and operational issues, the efficiency of effluent and sludge use as well as the problem of acceptance

and dissemination of PE-BGP. They call for a more intensive farmers' participation in the research as well as in the dissemination process.

In recent years ecological sanitation has gained increasing interest both, in the issue of water supply as well as wastewater reuse in agriculture. Regarding the use of human feces in agriculture, Justus Liebig stated in the 19<sup>th</sup> century that "(...) anything is comparable to that value, the oldest of all agricultural active populations, the Chinese, accredits to the human feces; the law of the state prohibits the pour away of the same, in every household reservoirs are built with highest accuracy, in which they are collected; never, another fertilizer is used for the grain fields." (GUTTERER 1997: 63).<sup>11</sup>

Hence, the question arises if apart from animal (piggery) waste, also human feces is acceptable for the production of biogas and furthermore, if the use of this kind of biogas sludge is acceptable as fertilizer (KOSSMANN A. PÖNITZ 1999: 39). Possibly the connection of sanitary latrines to biogas technology is a solution to constraints of acceptance and dissemination of both, ecological sanitation as well as the use of BGP.

### ***3.3.3 Ecological Sanitation - Opportunity for Compound with Biogas Technology in Integrated Agriculture Systems***

In East and South-East Asia reuse of wastewater counts on old traditions. Accordingly, especially in China and Viet Nam wastewater, animal and human feces have been used for centuries as cheap and reliable resource for agriculture as well as aquaculture (BLACK 2002: 10f; MCGARRY A. STAINFORTH 1978: 6ff; WINBLAD A. SIMPSON-HÉRBERT 2004: 71).

Today, regarding the issue of sanitary infrastructure, there are several driving forces working in favor of the development of ecological sanitation systems, due to the concept of long-term sustainability to reuse natural resources. Freshwater resources are scarce in many parts of the world and even where they are abundant, lack of capital anticipates investment in conventional sanitation systems. Further, advanced sewage treatment plants are expensive and many times inadequate and degrading to the ecosystem, its surface and ground water quality. Today more than 95 % of sewage in developing countries is discharged untreated.

Furthermore, the intensive agriculture with in many cases not sustainable farming practices, provokes a continuing decline in soil fertility. Consequently, combined with an increasing urban population consuming agricultural products, this leads to a massive lack of nutrients in rural areas. The cycle of nutrients and organic substrates is not closed and leads to a severe problem for the agro-ecosystem and thus for food security in the long-term.

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11 Original source: Justus Liebig, 1846: Die Chemie in ihrer Anwendung auf die Agricultur und Physiologie, 6. Auflage. Cited according to Gutterer (1997) and translated by the author.

Ecological sanitation regards human feces as a nutrient resource rather than waste. Together with the organic waste of food consumption they contain almost the same amount of nutrients as the food consumed (MÜLLEGER A. LECHNER 2004: 5). According to the statement on ecological sanitation on the 3<sup>rd</sup> World Water Forum in Kyoto in 2003, ecological sanitation is a holistic approach to save water, prevent water pollution, to sanitize and recycle the nutrients and organics in order to restore soil and soil fertility. The basic principles for its sustainable acceptance are the consistency with cultural and social values and to meet the needs of all household members considering gender, age. Further it should be easy to construct, to use and to maintain with local available facilities. Last but not least it has to be accessible to households of all kind of social status in the community (WINBLAD A. SIMPSON-HÉRBERT 2004: 4ff).

In Viet Nam, the issue of clean water supply and sanitary latrines has become high priority since the approval of NRWSS, although already in the decades before the country tried to improve sanitary conditions. In the 1960s, the Vietnamese Government initiated campaigns with the objective to improve ecological sanitation in the northern countryside using the agricultural cooperatives. Promotional operations like the “Clean House – Fertile Field” and “Building Three Sanitary Works: Water Wells, Bathrooms and Toilets” encouraged operating farm households to increase agricultural production and improve sanitary practices in rural areas. In this scope the Government encouraged the farmers to install double-vault composting (DVC) latrines, which accomplished an improvement of sanitary infrastructure on the one hand and an opportunity to use feces for agricultural production. But the war also ruined these early sanitation interventions. Apart from economic difficulties, the lack of required skills and materials in the countryside as well as the resulting disruption of community life, there were other things of definitely higher priority (ADCOM 2002: 4f). In recent times the increase of population density is high and the development of the industrial sector fast. Hence, environmental institutions and governments become aware of the looming fresh water crisis. They have recognized that the reuse of wastewater for agriculture may be a low cost solution in water treatment and at the same time a significant contribution to food production. Viet Nam, as a low-income country is unable to provide an appropriate centralized wastewater treatment infrastructure (NGUYEN TUAN 2001: 1).

Accordingly, in the case of Can Tho no centralized wastewater treatment is featured. The inner part of the city is connected to a sewer to a certain extent. Septic tanks are used in the city and in suburban areas. Measures of maintenance such as pumping are not reported and the tanks frequently are in contact with groundwater. These circumstances hold a hygiene risk as pathogens may be emitted to the groundwater. The septic tanks are promoted by the local health institutions, in many cases with international funds.



In rural areas most common are fishpond-latrines<sup>12</sup>. As long as they are installed above the fishpond, they are still tolerated, but not above open water like rivers, canals, etc. as they are forbidden by law (Decree No. 36 CT/TW dated June 25<sup>th</sup>, 1998) (MARD A. MOC 2000: 38).

Due to the NRWSS as strategy for an improvement of water management on national level, especially of the sanitation issue, first measures have been various projects in order to test many kinds of latrines and additional installations to find the appropriate way for each environment.

But till today, problems with the models' design and use of sanitary latrines have occurred in many cases. Latrines have been built and not accepted by the population due to disregard of socio-cultural values and traditional behaviors. Especially the will to use the night soil was not respected because of the hygienic unsafe character of utilization. As a result, people destroyed the septic tanks to have access to the organic matter (MUKHERJEE 2001: 8ff). Further, despite the average coverage of sanitation on national level, studies have shown the different accessibility of poor, middle and high income households as well as the difference between urban and rural areas. Apart from that, people often do not change in behavior as quick as the infrastructure is built up. They need education and time to make their experiences for a sustainable use of sanitation infrastructure. New installations need detailed analysis in a participatory way to lead to the aspired acceptance behavior (ADCOM 2002: 17ff).

However, especially in Viet Nam ecological sanitation may be the appropriate solution. Apart from the typical cycle of ecological sanitation, to compost the night soil to fertilizer, there is the opportunity to combine biogas technology with sanitary latrines in an integrated farm system (BLACK 2002: 12). In addition to many synergetic effects in investment, operation and maintenance, the problem of the substrate's hygieneization for fertilizer application may be solved in a comfortable and efficient way - an opportunity to close the loop with hygienically safe substrates.

### **3.4 SANSED-Project – Closing Nutrient Cycles with Hygienically Safe Substrates of Decentralized Water Management Systems in the Mekong-Delta**

The framework of NRWSS aims that half of Viet Nam's households should have access to "hygienic" sanitation facilities and 80 % to fresh water supply with "domestic quality" (not drinkable but for domestic use) by the year 2005. This includes measures to reach a widespread adoption of good personal hygiene behaviors. The long-term view of these objectives and activities are proposed to grow to universal coverage with drinking water supply, hygienic sanitation facilities and

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<sup>12</sup> This kind of latrine in most cases is a kind of wooden shack installed above the fishpond. The human feces are used traditionally for aquaculture production (*cp. Appendix 3-2*).

universal adoption of good hygiene behaviors by 2020 (ADCOM 2002: 5f; MARD 2000: 11ff). These objectives have stirred substantial interest for a feasible approach of introducing a decentralized wastewater treatment system. Especially in the Mekong Delta, an area with high agri- and aquaculture production is predestinated for a solution to reuse its resources. Consequently, the questions arise how to introduce decentralized wastewater systems in the rural area at household level in accordance with the people's deeply rooted sanitation habits? What is needed to ensure the sustainability of an improved ecological sanitation system? Is a modification in land use practices needed? What relationships exist between environmental and hygiene awareness and the acceptance of innovations on a decentralized wastewater treatment system? What factors motivate or discourage people from investing in their own biogas plant and/or sanitary latrines? How can the appropriate construction and technical maintenance be secured? What interventions and time frames are needed to effect a change in attitudes and a sustainable acceptance of new technology?

The SANSED-Project tried to find answers to such questions by developing an interdisciplinary research approach in three communities of the Province Can Tho. As the required data were not available, the SANSED-team followed an empirical research approach.

#### ***3.4.1 Description of the SANSED-Project***

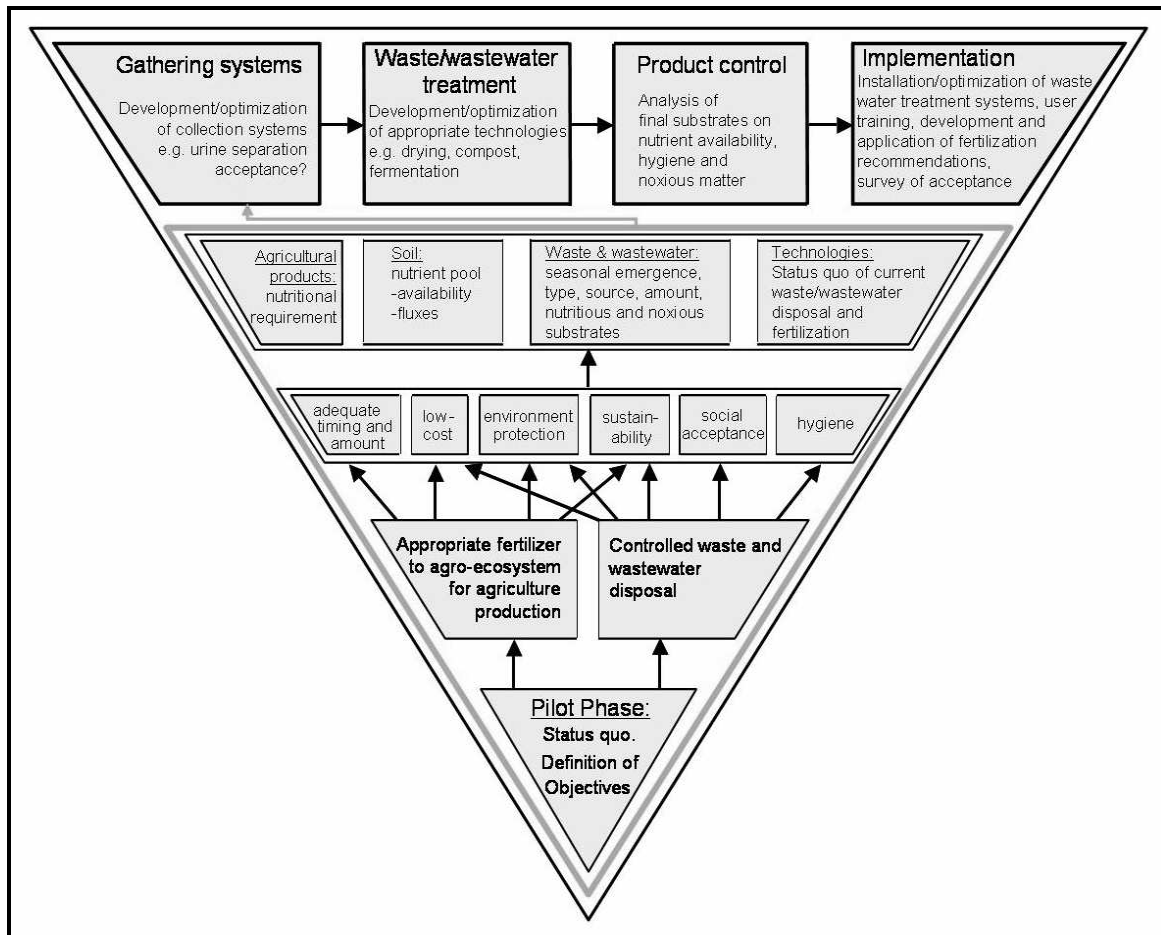
The SANSED-Project was initiated by the Institute for Plant Nutrition of the University of Bonn responding to the call for proposals "Decentralized Water Supply and Wastewater Disposal Systems" by the Federal Ministry of Education and Research (BMBF). The principal objective was to develop low-cost, quasi-self-sustaining systems for urban and rural settlements. Great importance was given to integrated approaches combining new technologies as wastewater treatment and energy production through biogas technology. Hence, the Universities of Bonn, Bochum and Can Tho, Viet Nam developed the SANSED-Project "Closing Nutrient Cycles with Hygienically Safe Substrates of Decentralized Water Management Systems in the Mekong-Delta". This initial project was carried out in close cooperation of all project partners in the period from December 2002 to 2004. The SANSED-team was composed of the workgroups Agro-ecology, Nutrient-fluxes, Hygiene, Hydrogeology, Irrigation & Drainage and Economic Sociology following an interdisciplinary approach in three research sites of the Province Can Tho. These groups were tandem teams constituted of German and Vietnamese scientists. The objective of this pilot project was to investigate the present situation gaining insights about what it takes to optimize and scale up successful ecological sanitation programs in Viet Nam.

### **3.4.2 SANSED's Research Concept**

In developing countries like Viet Nam wastewater treatment is still scarce. Furthermore, the according infrastructure generally is built up first in the cities. Even here the poor infrastructure hampers the installation and maintenance of a centralized water management system that requires high capital investment, which in most cases is dependent on international cooperation fund. From the ecological point of view, centralized wastewater treatment “eliminates” but not recycles nutrients. As an alternative, decentralized systems may treat the water and offer the opportunity of nutrient reuse in agriculture. As they are decentralized, the required capital is less, the provision can be developed step by step and the institution building to run and maintain the systems meets smaller units. As already described in *Chapter 3.1* the key constrain for the usage of wastewater substrates is the hygienic aspect. The treated water and sludge has to be hygienically safe and match site specific demands depending on soil and plant production. Implementation of decentralized wastewater treatment systems to use both, animal and human feces in agricultural production in a hygienic, economic and ecological appropriate way is seen as an effective loop-approach to the present water and health crisis. With an interdisciplinary team of six workgroups the SANSED-Project tries to identify criteria in each subject to develop in a participatory way a sustainable wastewater treatment system that meets the regional needs.

Therefore, the project group Nutrient-fluxes evaluates the amounts and (chemical) quality of water, nutrients and selected heavy metals through the system household, piggery and fish-pond. The efficiency of existing treatment systems such as anaerobic digestion, composting and vermiculture are analyzed. The workgroup Hygiene examines the quality of drinking water on the way from well, river or rain to the user. Furthermore the quality of waste water after treatment will be investigated. The team Agro-ecology focuses on the substrates from water and waste management for their use in plant production. Agro-ecological needs of the system are identified and demands on the substrates from wastewater treatment systems are defined. The project group Irrigation & Drainage examines the water use for agriculture at the sites to optimize the use of the substrates / organic fertilizer from wastewater treatment systems. Further, the workgroup Hydrogeology analyzes the water resources for drinking water purposes including investigations on ground water, surface water, rain water and use of water in the project areas. Finally, the workgroup Economic Sociology studies the farm households' socioeconomic environment, exposure of common water and waste use and the acceptance of new management systems.

*Figure 3-2* illustrates the principal steps of the study's approach to develop decentralized wastewater management systems.



**Figure 3-2 : Approach For Development of Decentralized Wastewater Management** (Source: modified, unpublished report 2003)

In conclusion, the research study wants to present detailed information on each single issue to enable precise recommendations to the development of a functional, socio-cultural adapted solution in ecological sanitation technology of an integrated farm management. This will support the prevention of water pollution and waterborne diseases in the Mekong Delta, Viet Nam. Therefore, the output of the pilot phase of SANSSED-Project will be a handbook that may be used as guidelines to realize decentralized water treatment systems based on such an interdisciplinary research approach.

## 4 Determinants of Attitudes and Acceptance towards New Technology in Operating Farm Households

### 4.1 Theoretical Remarks on Attitude and Acceptance Analysis

The present study deals with attitudes towards and acceptance behavior of various interlinked innovations, which will be evaluated from the users' and non-users' point of view. Therefore, the principal terms like acceptance research, attitude and acceptance behavior as well as innovation are defined in general. The model of farm systems in the tropics and subtropics (DOPPLER 1991) describes the operating farm household's position as acceptor in Viet Nam. The acceptance behavior of the regarded innovations will be allegorated with the character of a decision-making process by an individual, in this case the household head, according to LANGENHEDER'S theory. It constitutes the influencing dimensions on the operating farm household as well as the interceding variables concerning the innovations' attributes perceived by the household head. In addition, KOLLMAN'S multilevel acceptance-model (1998) aims the analysis of the acceptance to use an innovation instead of only adopting it. Hence, it will be explained and discussed as the objective is to prepare the study's concept on attitude and acceptance analysis for a sustainable introduction of the innovations.

#### 4.1.1 Introduction to Attitude and Acceptance Research

The classical acceptance research is undertaken from the sociological point of view as an approach that sets on the user side of innovations, in order to ascertain the reasons for and against acceptance.

Acceptance research has two principal issues to be investigated. An analytic objective, which tries to explain the interrelations between the introduction of innovations and their impacts, and an arranging objective, which is aligned to an influence of the arrangement of innovations regarding the utilization by its user (MANZ 1983: 53, 175; REICHWALD 1978: 22f). Nevertheless, principal subject-matter of the acceptance research is a prognostic purpose, contrary to the research on adoption and diffusion. Latter tries to find answers to the question of time and factors an innovation disseminates in a social system, whereas acceptance research concerns the attitudes and acceptance of an innovation by an individual. Therefore the central elements of the acceptance research are:

1. The terms of **attitude** and **acceptance** (What means attitude towards and acceptance of an innovation?),
2. the **innovation** (What kind of innovations will accepted?), and
3. the **acceptor/user** (Who will accept to use an innovation when and how?).

In the diversity of acceptance models the user and the innovation are correlated in consideration of their relating field, environment and overall of the acceptance definition.

The **definitions of acceptance** are versatile, but in its mainstream they are very similar. Thus acceptance

- ↳ from sociological point of view is similar to the term of social compatibility, the characteristic of an innovation to attain positive reactions by the target group during its introduction (ENDRUWEIT 1989: 9),
- ↳ is a mental process, which humans go through, beginning with the first report about an innovation until its final acceptance (FEDER (ACC. ROGERS 1962) 1984: 256), or
- ↳ contradicts the term rejection and designates the positive decision to accept an innovation by the user (SIMON 2001: 87).

LUCKE (1998: 21) states that acceptance depends on many factors from both sides subject and object. Thus it is not defined solely by scientific objective criteria. Further, the decision to accept is a dynamic process and hence an earlier rejection of an innovation might be turned to acceptance due to changing conditions of the individual's environment. Acceptance is seen as an affirmation of the user group regarding objective criteria as well as subjectively perceived attributes of the innovation influenced by cultural, political and other attitudes (ARNOLD 1998: 34).

In the economical acceptance research the allocation in attitude acceptance and behavior acceptance became generally established (MUELLER BOELING A. MUELLER 1986: 26; KOLLMANN 1998: 51f).

The **attitude acceptance** covers an affective and cognitive component. The affective component reflects the motivation-emotional evaluations of the innovation. The cognitive component of the attitude acceptance balances the attributes (costs, use, comfort, etc.) of the innovation with consideration of the personal surroundings. Together it shows the disposition for an action. As the attitude acceptance bases on a person's internal psychological structure, it is not directly observable.

The **behavior acceptance** extends the acceptance term by the conative component. On this level an acceptors' behavior (e.g. purchasing and use) is observable in relation to the innovation (MUELLER BOELING A. MUELLER 1986: 26f).

This distinction of attitude and behavior acceptance is based on the "Three-Component-Model" of attitudes according to ROSENBERG AND HOVLAND (FREY A. MOEHLE 1989: 135).

Consequently acceptance bases on a more or less positive attitude of a person or group towards an object, subject or some kind of issue (KOLLMANN 1998: 51). That means that acceptance is understood as development out of attitude and can be explained by the social-psychological concept of attitudes. Therefore a closer look at the term of attitude is necessary.

The scientific **research on attitudes** comprehends the formation and change of attitudes as well as the methods to measure them. The overall objective is to investigate the conditions, due to which attitudes (verbal behavior, behavior dispositions) can be used to predict behavior patterns (observable behavior, actions) (MUMMENDEY 1979: 14).

Thus the relationship between attitudes and behavior is still the most problematic aspect of research and remains of great significance (KOSCHNICK 2004).

In the first instance, attitude can explain a short- or long-time orientation towards an object. Then attitude was used as different types of cognitive orientations and was subsequently established as a term for long-time orientation towards objects (MUMMENDEY 1995: 30).

Among a variety of definitions of the **term attitude**, the following two examples are taken to bring forward the basic dimensions of attitude formation.

- ↪ Attitude indicates the way, how an individual directs not in its openly observable behavior, but in its thoughts, feelings, evaluations, and if necessary its behavior intentions and/or intentions toward a social object (MUMMENDEY 1995: 30).
- ↪ FISHBEIN A. AJZEN (1975: 6) describe attitude as "(...) learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object".

Thus attitudes are a learned cognitive structure and the observable behavior finally is a function of beliefs about various objects, actions and events, which a person acquires and loses during the course of life. That means attitudes are something "inner-personal", which can have impacts on the person's behavior and that is influenced by itself or even changed by the realized action.

A further part of the attitude sphere is constituted by the consequences of use or speculation of usefulness. The combination of affective-evaluative and cognitive components defines the precise attitude of a person towards an objective (AJZEN A. FISHBEIN 1980: 100).

However, the most common approach is the "Three-Component-Model" by ROSENBERG AND HOVLAND (FREY A. MÖHLE 1989: 135). It asserts that attitudes are composed of the trilogy of human experience by thinking/belief, feeling/emotion and willing (MUMMENDEY 1995: 31). Hence, the three components are

1. the **cognitive component**, which refers to the person's awareness of and knowledge about some object or phenomenon,
2. the **affective component**, which refers to the subject's liking and preference for an object or phenomenon, and
3. the **conative component**, which refers to the individual's intention-to-act and actual behavior.

Questionable is, whether the conative component can be integrated into the term attitude or whether it is an independent dimension apart. Concerning this matter it

should be evident that attitude only includes the disposition to act in relation to the object, but not the already realized action or behavior.

This calls for the discussion of the ***cognitive theory of consistency***, which asserts a close relation between attitudes and behavior and that a person on the long run always aims to reach a consistent situation (KROEBER-RIEL 1996: 305; MUMMENDEY 1979: 15f). The value of attitude research comprises the possibility to forecast a behavior on basis of the individual's attitude. The cognitive consistency theory assumes that between attitude and behavior a relative close relationship exists. In case of contradictory (inconsistent) relationship the individual is desirous of reestablishing a consistent situation by changing its evaluation or action (MUMMENDEY 1979: 15f).

But various authors like DEGENHARDT (1986: 90), MUMMENDEY (1979: 16f) states that the empirical proof of a clearly defined and observable relation between attitude and action is unlikely or even failed. Thus the question arises if under these circumstances attitudes can be used for the prediction of action.

In this context KROEBER-RIEL'S definition of attitudes on the basis of the neo-behavioral research tradition, as interceding variables which explain behavior patterns by non-observable, intrapersonal circumstances, play an important role (KROEBER-RIEL 1996: 29f, 305). Therefore he differentiates the usefulness of attitudes for behavior prediction dependent on the type of the measured attitude and mentions that

- ↪ with regard to the attitude specificity the same level of universality of attitude and behavior has to be presumed,
- ↪ directly lived experiences towards the innovation are more reliable than indirect experiences,
- ↪ directly available attitudes are more significant than attitudes after detailed evaluation, and that
- ↪ attitudes should feature a certain steadiness.

AJZEN A. FISHBEIN (1980) also come to a positive conclusion as they see the person's intentions as a relevant link between subjective values, attitudes and specific action (DEGENHARDT 1986: 90ff).

Getting deeper into detail, it is interesting not to remain on the level to know whether an attitude is positive, neutral or negative, but to measure them by values (HERKNER 1991: 185f). Therefore scales of attitudes have been developed for a broad range of subjects and underlie a steady development due to the prospected objective. Such scales contain a list of statements referring to an object (innovation), which in an empirical study has to be assessed by the target group.



According to this the individual factors of personality are of interest for the interpretation of different attitudes' impacts on behavior. LANGENHEDER assumes that between the constitution of the person's social and physical environment and its behavior a direct relationship is not existent. But an influence is so far given as the person's environment infiltrates in its internal psychological structure. Determinants for development and change of cognitive conceptions and motivations are primarily experiences and contents of information as well as the kind of the information transmission, which the person obtains by interaction with others (LANGENHEDER 1975: 60). Sources for attitudes are primarily information through direct and indirect social interaction, observation and the respective conclusions.

In consideration of this issue the socio-cultural environment with its values and possible social forces is identified as an important aspect for the attitude-action-consistency.

Parallel to attitudes the expectance pressure of third parties and social norms play an important role for the person's decision-making process to use an innovation. AJZEN A. FISHBEIN (1980: 84) distinguish here the person's assumption about the expectance of relevant social groups and the individual disposition to meet these expectancies. Thus, the closer and the more intensive the person's involvement in the local social live, the higher the importance of these norms and expectancies.

Due to this symbolic appreciation, which refers to the object itself, the trademark or the implemented technology, plays a role in the sense of negative or positive connotations. Examples for this scope of attitudes may be progressiveness, modernity, wealth, independency, cosmopolitanism or open-mindedness. This kind of appreciations is denominated as 'user images' (AJZEN A. FISHBEIN 1980: 100).

Last but not least the hypothesis of scarcity should be mentioned. MASLOW (1970) illustrates by means of the pyramid of necessity, that items which are relative scarcely available are higher appreciated by an individual. Meanwhile this may be less valid for the highly developed industrial nations, but the more suitable for a development country in "Doi Moi" as Viet Nam.

Finally to simplify and define the terms of use in this study, attitude reflects only the intention to a following behavior. Hence, adoption is seen according to KOLLMANN as the intermediate level of action in the sense of purchasing but not use of the innovation (*cp. Chapter 4.1.5*). Whereas acceptance will be used in the sense of concrete actions and experienced usage of the object. Thus attitude and acceptance may not be equated under any circumstances.

Beyond the cognitive and affective attitude formation and an aligned disposition for action, a comprehensive acceptance term requires also the real value of use on the conative level.

#### **4.1.2 Meaning of the Innovation for the Acceptance Behavior**

The word innovation has its origin in Latin word “innovatio”, which means renewal and/or creation of something new. In the broadest sense innovation represents all new (ARGEGER 1976: 101). ROGERS (1995) defines in his comprehensive book “*Diffusion of Innovation*” diffusion as the process by which an innovation is communicated over time through certain channels among the members of a social system - thus innovation as an idea, practice, or object that is perceived as new by an individual or another unit of adoption (ROGERS 1995: 11).

Consequently, an innovation is on the objective level something for the entire environment not yet well-known and on the subjective level something for a certain individual not yet well-known. Whether it concerns an objective or subjective innovation, the time dimension is crucial. In the course of time therefore a formerly objective innovation can today represent only for the uninformed user a subjective innovation (ROGERS A. SHOEMAKER 1971: 19).

Research concerning the diffusion of innovation has increased significantly over the past several decades due to its versatility. Introducing technological innovation in wastewater management and agriculture, the operating farm households' acceptance presents a complex set of challenges. According to ROGERS, one reason why there is so much interest in the adoption and diffusion of innovations is because "getting a new idea adopted, even when it has obvious advantages, is very difficult" (ROGERS 1995: 1). Further, ROGERS defines the innovation-decision process as the process through which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision.

Subsequently, ROGERS categorized farmers according their individual innovativeness basing on their time of adoption. The individuals who are predisposed to being innovative will adopt an innovation earlier than those who are less predisposed. Due to his theory, the adoption behavior follows a lognormal distribution that can be divided into the groups of “**Innovators, Early Adopters, Early Majority, Late Majority and Laggards**”. On the one extreme of the distribution are the innovators (2.5 % of the system's individuals), individuals with pioneer character; willing to take risk adopting an innovation very early. On the other extreme are the laggards (16 % of the system's individuals) who resist adopting an innovation until rather late in the diffusion process, if ever. The early adopters (13.5 %) represent the group of opinion leadership, are highly esteemed and hold the function of multipliers of experienced information for potential adopters. The groups of early and late majority (34 % each) are more sensitive, require in-depth information and react cumulatively skeptic asking for the innovation to be proved for a longer time.

Further, ROGERS identified five characteristics of innovations in his model of different adoption rates.

- ↪ Relative advantage – proven advantage/usefulness of the innovation.
- ↪ Compatibility – compatible to the adopters' norms and values.
- ↪ Complexity – the higher the innovation's perceived ease of use the higher the adoption rate.
- ↪ Trialability – requirement of a demonstration and testing-period.
- ↪ Observability - observable results of an innovation.

For the achievement of objectives within a political program set in a defined time frame, e.g. the improvement of water supply and sanitation (NRWSS), it is essential to meet these criteria in order to enable the necessary diffusion process from innovators to early and late majority.

Notable about ROGERS' model is that the technological superiority of an innovation plays a minor role in determining the rate of adoption. But he emphasizes the importance of the adopter's social and cultural environment influencing the rate of adoption. Likewise GARLAND (1991: 283) states that major obstacles during the adoption and diffusion process of an innovation are "people issues, including cultural traditions, risk aversion, lack of knowledge, and user acceptance".

According to this, acceptance and diffusion cannot be based solely on innovation's worth or quality. But both, the potential user, their culture, necessities, opinions and environment as well as the users' perception and evaluation of the innovations' attributes affect to a large extent his acceptance behavior (ADESINA A. ZINNAH 1993: 298; ADESINA A. SEIDI 1995: 358). Thus, this compound of aspects should definitely be considered within an acceptance analysis.

#### **4.1.3 Position of the Operating Farm Household as Acceptors**

In the rural areas of countries in development and transformation with predominantly subsistence or subsistence- and market-oriented operating farm households the enterprise and household can't be separated clearly, but represent a closely linked, socio-economic system (DOPPLER 1991: 12). Accordingly also PIORKOWSKY calls for the identification and analysis of an operating household as a functional unit and thus the abandonment of the traditional rigid division of labor between agricultural business operations and household economy (PIORKOWSKY 2000: 8). Corresponding to the classification of agricultural operating systems of the tropics and subtropics the households in the Mekong Delta can be defined as subsistence- and market-oriented operating farm households frequently with lack of resources in land and water using irrigation cultivation with their own water procurement by natural flooding (DOPPLER 1991: 141; PAYER 1998: 27). As the operating structures of the former and present socialist states (China, Viet Nam, Cuba, etc.) are subject of a substantial

transformation process, this classification can only be an approximation to reality (PAYER 1998: 3). The acceptance analysis of these complex operating farm households requires an integrated approach, which orients itself at the actual problem situation and multifaceted structure of objectives. That is according to DOPPLER (1991: 12) the comprehension of economical, technical, sociological and psychological points of view. The traditional farmer of the tropics and subtropics cannot only be seen as a “homo oeconomicus”, acting strictly on the ideal conceptions of the free market economy (OHE VON DER 1985: 101). Rather the human being itself which operates this system as well as its socio-cultural surroundings plays an important role on the decision behavior referring to acceptance of innovations. That means noneconomic factors like self-esteem and prestige instead of profitability may be the reason for an investment and the pursuit of independence could be decisive to stay on-farm (ARNOLD 1997: 68). Both aspects, the rational choice as well as the human, individual factors influencing a decision, have to be considered.

Therefore DOPPLER (1991: 14ff) states the following requirements for a research approach on the operating farm household's level:

- ↪ The decision making is affected by its people needs and goals.
- ↪ The farm and household are means and not the end in itself for the family members. Thus all agricultural activities are instrumental and goal-oriented.
- ↪ The awareness of the decision maker that needs and goals are of sustainable nature and require a risk-minimizing behavior in the long run.

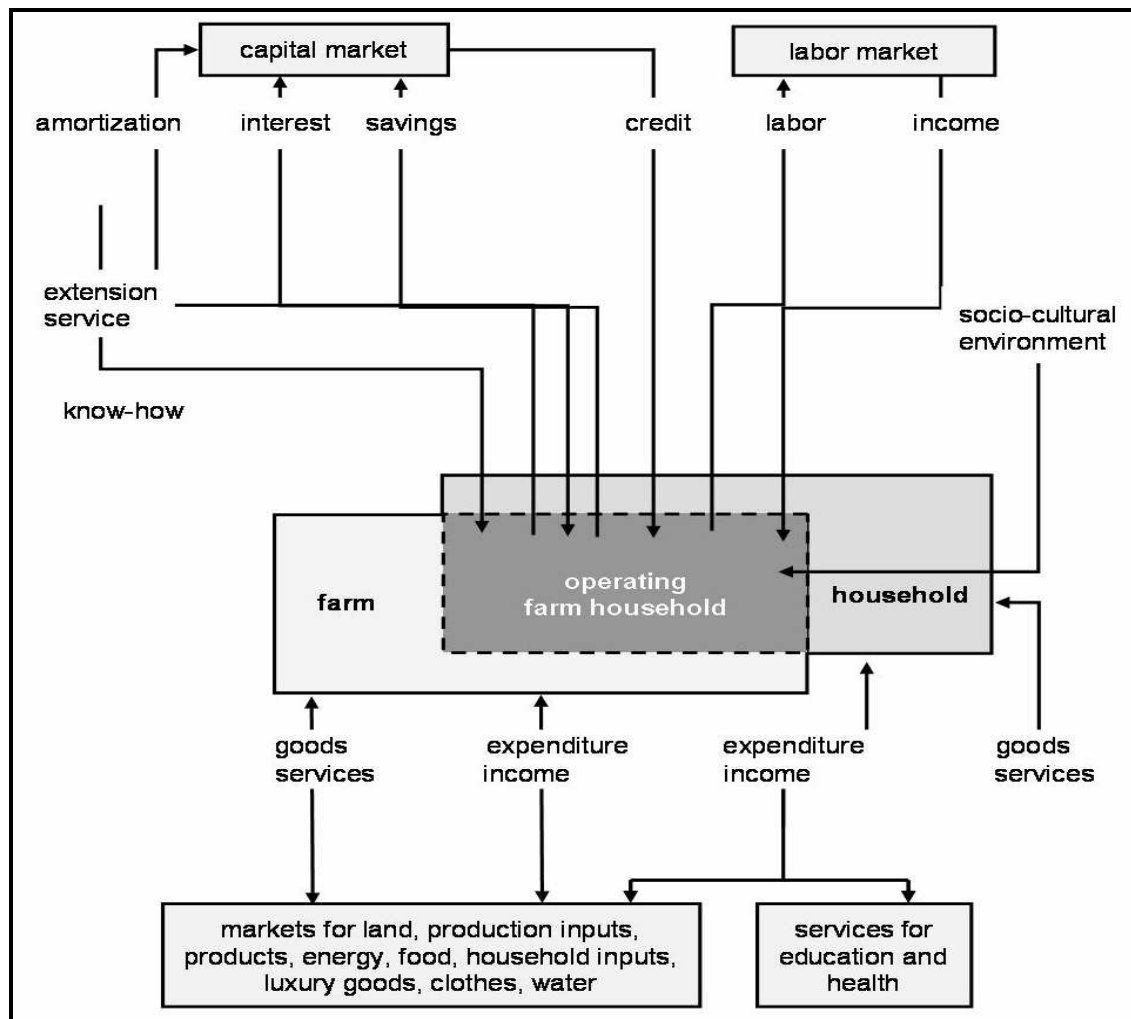
On the operational level the decision making process is subject to several external factors:

- ↪ **Social conventions**, cultural norms as well as religious taboos have high influence especially for the introduction of technical innovations. Thus its social and cultural compatibility has to be checked.<sup>13</sup>
- ↪ **Local physical environment** including climate, condition of soil, water and vegetation as well as the situation of diseases and plagues.
- ↪ **Information**, from extension service and social interactions until the own initiative for information acquisition the more the farm system switches from traditional subsistence to market-oriented character.
- ↪ **Institutional, administrative and political conditions**. Especially in communist or socialist states this aspect is of high value.

These external determinants for the decision making process generate, in dependency on the operating farm household's internal objective of resource allocation, the external relations as illustrated in *Figure 4-1*.

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<sup>13</sup> Doppler states this aspect first of all, even before the natural conditions, which underlines the importance of this aspect.



**Figure 4-1 : The External Relations of the Operating Farm Household in the Tropics and Subtropics** (Source: Modified acc. to Doppler 1991:15)

These aspects like labor mobility, capital, other resources, products and services are evaluated by the operating farm household's needs and estimations according to their priority. Sociological variables as information, consultancy and other forms of social interaction affect or even control this intrapersonal process (DOPPLER 1991: 16). As Doppler's objective is to classify farm systems according to their external conditions, the resources use and production process, he does not dwell on the social-psychological reasons, the influence of individual perception and attitudes for decision making. In contrary LANGENHEDER (1975) gives an in-depth analysis on this issue in his '*Theory of Human Decision Making*'.<sup>14</sup>

#### **4.1.4 The Decision Making Theory as Further Column for the Acceptance Model' Conceptualization**

Acceptance models can base on behavioral decision making theories, as they deal with an individual's decision to accept or refuse an innovation (*cp. Chapter 4.1.1, theory of consistency*). The history of theoretical approaches dealing with behavioral decision making is diverse and shows notable differences. Nevertheless they can be

<sup>14</sup> Original title: „Theorie menschlicher Entscheidungshandlungen“ (Langenheder 1975:66)

assumed in three principle categories (LANGENHEDER 1975: 3):

1. The decision- and act-theoretical approaches, which are based on economics and applied mathematics constituted in a unified and closed system,
2. the motivation- and learn-psychological approaches, which are closely linked to the psychology of individuals and which show a great variety, and
3. the social-psychological-sociological approaches, which are partly based on the latter approaches but additionally try to explain the human decision making behavior in relation to situations of social interaction.

Thus, LANGENHEDER analyzes the three principle approach categories in detail, especially E.C. TOLMAN'S 'Model of Action' (1951: 287) which is already structured in independent, intervening and dependent variables, to develop his own 'Theory of Human Decision Making' (cp. Figure 4-2).

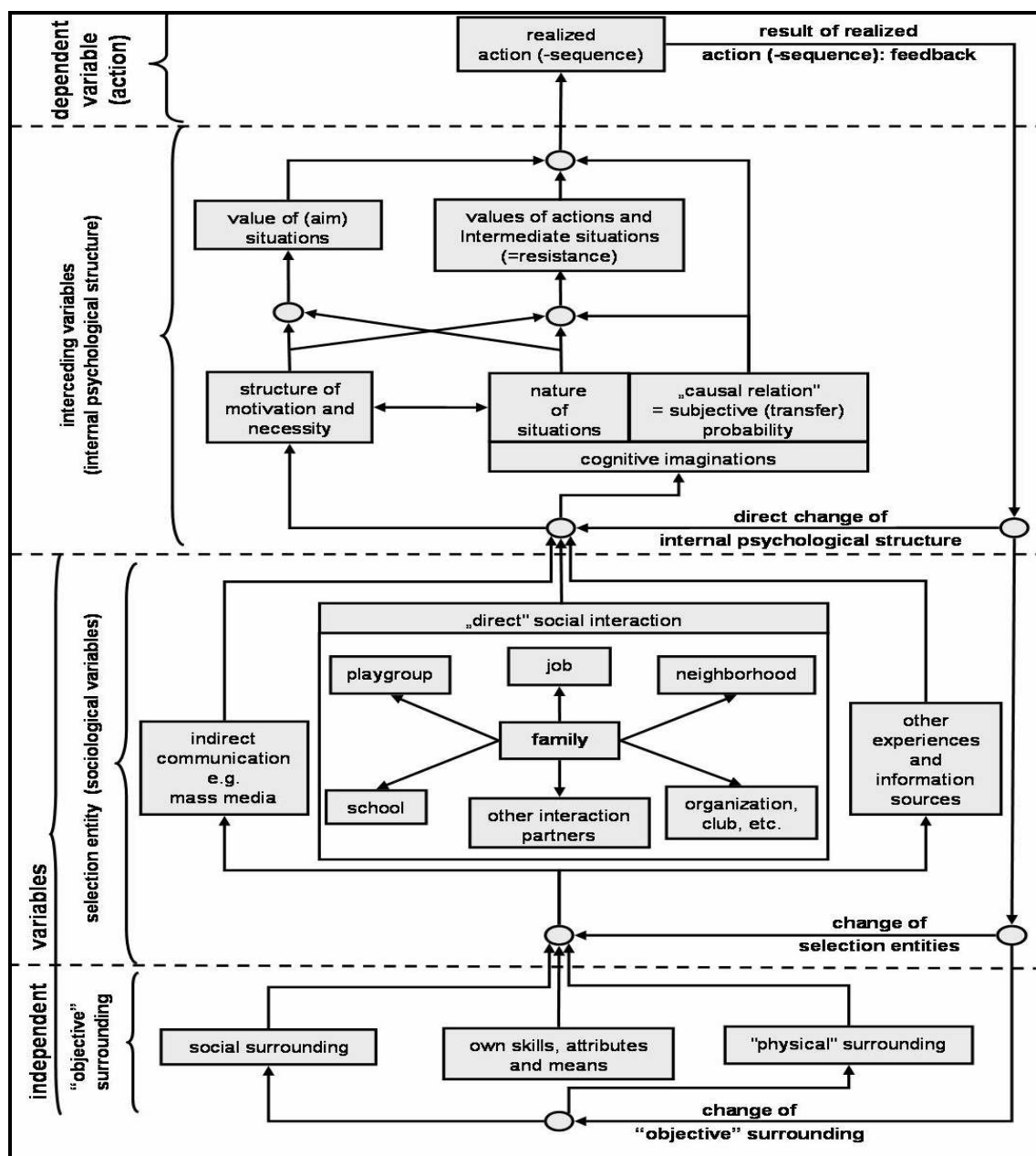


Figure 4-2 : Model for Explanation of Human Decision Making

(Source: Modified according to Langenheder 1975: 66)

Likewise to DOPPLER'S holistic approach of the operating farm system and its external relations, LANGENHEDER structures the determinants affecting the decision making process in independent and interceding variables. The independent variables are composed by the "objective" surrounding, which comprehends the social and "physical" environment, the person's skills, attributes and means. The sociological variables are a further part, which particularly describes the person's relationships for communication. LANGENHEDER distinguishes between direct social interaction and indirect communication by mass media as well as other experiences and information sources. The sociological variables act as so called selection entities, a filter for information diffusion from the "objective" surrounding to the person's internal psychological structure. He supposes that there is no direct relation between the person's social and physical environment and its behavior, as long as these aspects are not internalized in the person's psychological structure. Finally, the content of information and experiences as well as their influence on the internal psychological structure are ascertained by

"(a) the 'objective' nature of the physical and social surrounding,

(b) by the (social) selection entities (...) and

(c) by means of physiological and psychological mechanisms of perception and the information transmission and processing (...)" (LANGENHEDER 1975: 67).

For the study's implementation both parts of independent variables are described in the conceptualization within the six selected dimensions (*cp. Figure 4.4 and Chapter 4.2.3*).

The interceding variables act as links between the independent and dependent variables and can constitute both. The dependent variables are the action to be predicted, in this case, the acceptance for the analyzed innovations. The interceding variables comprehend the person's internal psychological structure (cognitive imagination, motivation, values). Here the coherence to KROEBER-RIEL'S definition of attitudes as interceding variables which represent non-observable, intrapersonal circumstances is apparent (KROEBER-RIEL 1996: 29f).

Recapitulating, the interceding variables compose the elementary link between attitude and action and thus they are vital for the purpose of acceptance prognosis.

#### **4.1.5 Acceptance Models – Kollmann's Multilevel Model for Acceptance of Use**

KOLLMANN (1998: 73ff) and subsequently SIMON (2001: 92ff) elaborated a detailed and critical analysis of a broad range of acceptance models. Accordingly the amount of models can be structured in two major categories<sup>15</sup>:

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15 For a more detailed overview of acceptance models in English-language literature it can be referred to Rogers and Shoemaker (1971), Triandis' "Technology Acceptance Model" (1991) as well as "Task Technology Fit Model" by Goodhue (1995), Davis' "Technology Acceptance Model" (1989)

- ↪ Input-output-models and
- ↪ Feedback models.

Generally Input-output-models consider variables, which affect the behavior of the users and measure the outcome, whereas feedback-models include the analysis on the influence of the users' behavior on future acceptance decisions. Both models follow an approach of a static situation with dichotomy yes/no acceptance value (KOLLMANN 1998: 86f). Maybe the reason for this "point-of-time-phenomena" is its feasibility. An approach with monitoring character requires much more time and finance to be realized than an evaluation. But apart of the time aspect a purely dichotomous approach for the analysis of acceptance is still insufficient, since nothing is stated about the extent and intensity of the acceptance (FEDER 1984: 283). Rather, a dynamic approach may be necessary if

1. the attitude of the target group changes frequently, or
2. the innovation is characterized as a dynamic system, which is influenced by itself or even changed by the utilization of the acceptor.

The question, which model type has the highest potential for explanation of acceptance behavior is not yet answered in literature. Beyond doubt, the users' versatile environment is a broad and important point of analysis as shown by DOPPLER and LANGENHEDER as well as in numerous studies of agricultural innovations (FEDER 1984; GUTTERER 1997; EPULANI 2003). Considering the attributes of innovations, the meta-analysis of DAVIS (1989) illustrates that there are repeatedly independent from the type of evaluated innovation, two major influencing aspects:

1. The perceived ease of use, and
2. the perceived usefulness.

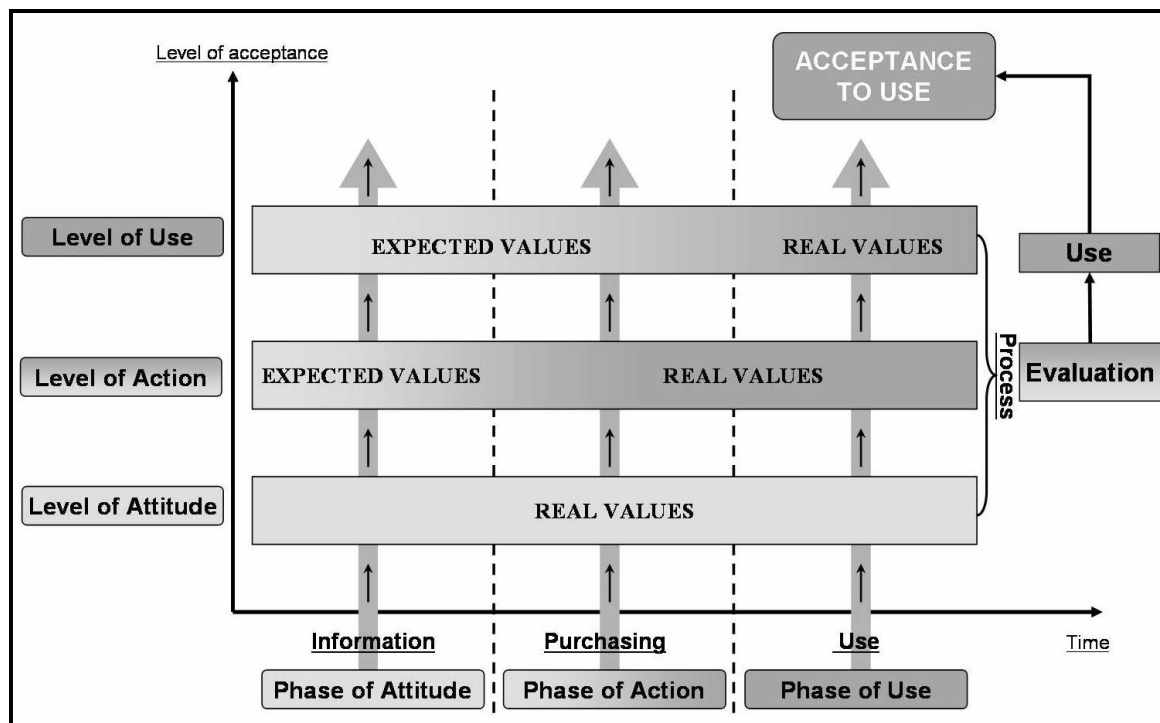
In practice ADESINA AND ZINNAH (1993: 298) emphasize that the perception of the innovations' attributes have an important influence on the acceptance behavior. Hence, the empirical results show consistency with the theoretical basis (*cp. Chapter 4.1.1*). Taking the multiplicity of acceptance investigations in the agricultural working field into account especially in developing countries, it can be stated that (FEDER 1984):

- ↪ There is a change from the classical dichotomy models to multi-value and multi-level models,
- ↪ a tendency to use a combination of quantitative and qualitative methods, and
- ↪ an overwhelming priority of analysis still basing exclusively on economic or socio-economic factors.



According to these facts, the acceptance model by KOLLMANN arouses major interest even though it is conceived for telecommunication and multimedia goods.

Acceptance models can be further distinguished into single-step and multi-level models. KOLLMANN divides the acceptance process into several phases and levels, whereby each phase ends up with a partial acceptance. The potential user runs the gamut beginning in the phase of attitude through the phase of action to the phase of use (cp. Figure 4-3).



**Figure 4-3 : Basic Structure of Acceptance Model** (Source: Modified according to Kollmann 1998: 106)

In the first phase the process is principally determined by awareness, interest and expectations. Respectively the attitude acceptance results from the values of the attitude level together with the expected values of the levels of action and use (KOLLMANN 1998: 92ff).

In the action phase the person's decision is influenced by demonstration/trial and error and includes the act of purchasing as well as the establishment of operational readiness (KOLLMANN 1998: 98ff)<sup>16</sup>. In doing so KOLLMANN declares adoption reached at the level of action in the sense of purchasing the object without detailed experience in use. This phase is equated with what in literature generally is called adoption. Assuming further positive decisions the person finally reaches the phase of use in which he specifies the operation and uses the innovation continuously over a long time (KOLLMANN 1998: 102ff). In conclusion KOLLMANN summarizes attitude acceptance, behavior acceptance and use acceptance, reached in consecutive periods of time, to come to a cumulative acceptance. Thus, KOLLMANN defines the

<sup>16</sup> Similar to Roger's „Triability“ cp. Chapter 3.1.2

acceptance process by the additional level of use. After each acceptance level the acceptance process can be interrupted or even broken off. Within this possibility the rejection may be

1. **temporarily** (may be the persons circumstances/attitudes have significantly but temporarily changed),
2. **definitely** (even this is almost unpredictable as future possibilities are not known at the moment), or
3. **leapfrogging** (the actual type of innovation is refused and instead the next but one type will be accepted).

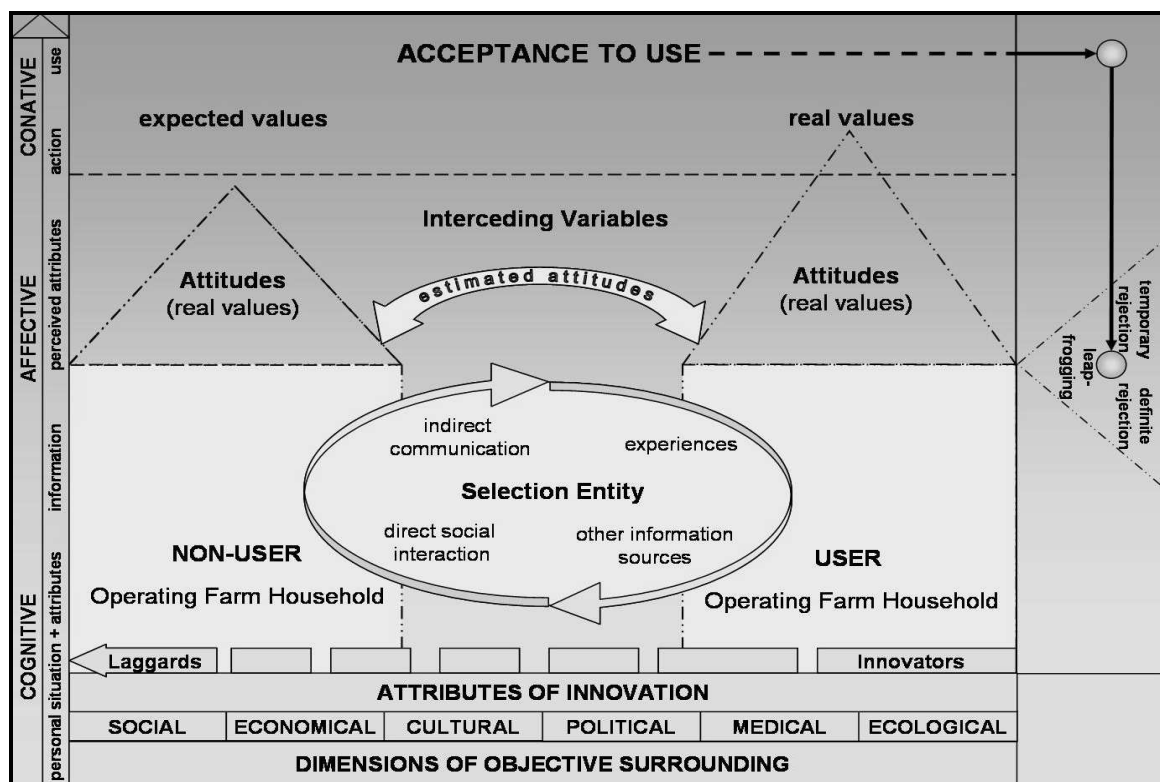
The model in *Figure 4-3* is an interesting approach to combine the different steps of an acceptance process. But it is to question whether it is possible and effective to add up three acceptance levels, since in the course of time the influencing factors may vary significantly. Furthermore, KOLLMANN assumes an intended rational concept for decision making according to SIMON (1966: 196). Although he includes the analysis of attitudes, he acts on the assumption that they base on an emotionless but cognitive component (KOLLMANN 1998: 94f). That may be realistic in the business world of telecommunications and multimedia but certainly not in agricultural environment of an operating farm system in Viet Nam. Nevertheless, in some variation this model may offer to analyze different steps of the acceptance process at one point of time. In the following Chapter KOLLMANN'S model will be combined with the approaches of LANGENHEDER and DOPPLER to elaborate a suitable concept to analyze operating farm households' attitudes and acceptance of new technology in wastewater management of the Mekong Delta, Viet Nam.

#### **4.1.6 Generated Model for Attitude and Acceptance Analysis**

In the scope of SANSED-Project it was necessary to combine the major issues of latest acceptance theory in a practical manner. In the following approach the operating farm household represents non-user and user and thus, stands in the center of interest. The acceptance of the regarded innovations will be allegorated with the character of a decision process according to LANGENHEDER'S model. Secondly it is the sustainable use and less the adoption, which is of interest for project implementation. Therefore it makes sense to reduce the levels of investigation to attitudes (attitude acceptance) and acceptance (use acceptance). Instead of surveying a user at miscellaneous steps of the acceptance process during different phases of time, different user groups at one time will be evaluated. Hence the non-user group, which has none of the focused innovations can be analyzed according to their attitudes towards the innovations, the user-groups give information about attitudes as well as acceptance. Both will offer information with real value according to their objective surrounding. Concerning KOLLMANN'S phase/level of action/purchasing, the first group provides expected and the user group real values

of attitudes towards each innovation. But it will not be seen as independent level of acceptance; neither will it be added up quantitatively. Furthermore the user-groups will give real value information about the acceptance to use.

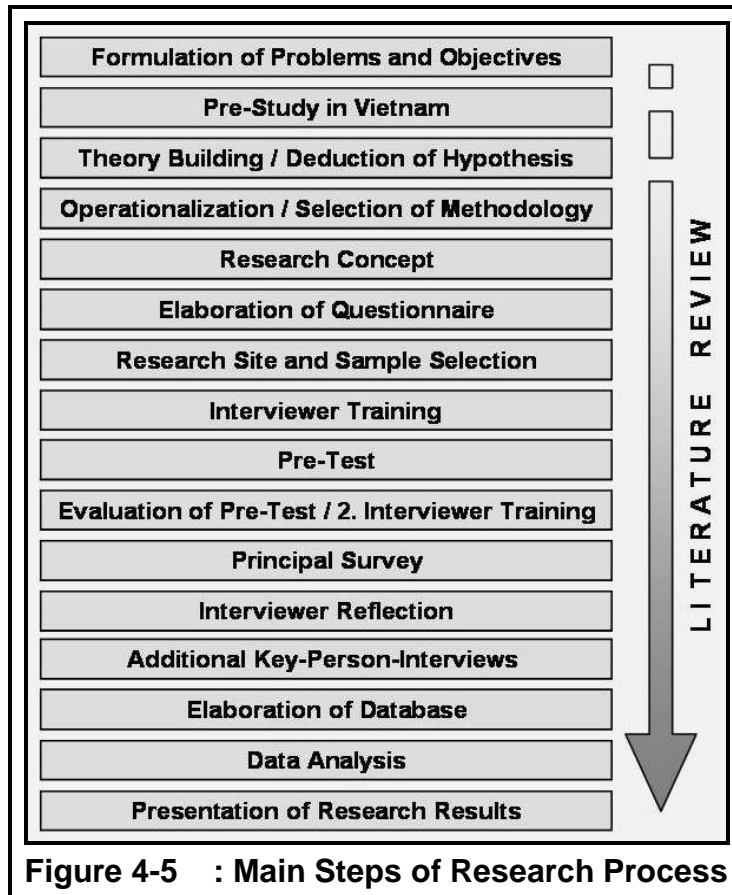
In the study the household groups are intergraded. Regarding the analysis of the objective surrounding (six dimensions), it is generally differentiated between user (OFH which use at least one of the considered two technical innovations) and non-user (OFH which use none of the considered innovations). In the scale of perceived attributes, the analyzed user groups refer to each single innovation (e.g. BGP-User and BGP-Non-user). Additionally, the analysis of mutual estimated attitudes will give interesting information in the sense of AJZEN A. FISHBEN'S pressure of expectancies and social norms (*cp. Chapter 4.1.1*). Not only the attitudes of each group are assessed, but each group estimates also the attitudes of the contrary household group (e.g. BGP-User estimates reasons of Non-Users). Finally, these results are compared to a small group of System-Users, OFHs which already use the three interlinked innovations as a system. These "Innovators" or "Pioneers", according to ROGERS'S theory on diffusion of innovations, might elucidate new or confirm the analyzed determinants for acceptance. The model has a feedback character as some users may have reinvested in BGP and furthermore, stand in communication through the existing mass organizations or direct social interaction with other household groups. The elaborated model for this study to analyze attitudes and acceptance of new technology in water management and sanitation is illustrated in *Figure 4-4*.



**Figure 4-4 : Theoretical Concept of Non-Users' and Users' Attitudes and Acceptance Behavior**

## 4.2 Conceptualization of the Research – Approach, Terminology, Instruments and Data Collection

According to the classical proceeding of an empirical research plan the main steps of the methodical conception are described in this chapter. *Figure 4-5* gives an over-



**Figure 4-5 : Main Steps of Research Process**

view of the complete realized research process to make the conceptualization traceable (FRIEDRICHS 1990: 51, 119ff; DIEKMANN 1996: 162ff). First, the study's approach is summarized and linked to a detailed elaboration of the main research aspects, which are based on the theoretical remarks. Within the determination of the dimensions and attributes, the surveyed aspects and terms are defined to formulate relating hypotheses. This is the base for the structure and elaboration of instruments. Subsequently, the research process and methods on site

are explained. Finally information is given on the data monitoring, processing and further analysis.

### 4.2.1 Research Approach and Concept

A major objective of the study is the understanding and evaluation of factors that affect attitude and acceptance of the sustainable introduction of a decentralized wastewater management system, which allows closing nutrient cycles with hygienically safe substrates in the research area. Principally the system is composed of a

↪ **Biogas Plant** (BGP), and a

↪ **Modern Latrine** (ML) connected to the BGP

The investigation concentrates on attitude and acceptance analysis of these technologies as well as on the third innovation of

↪ **Organic Substrates** (BGS) as fertilizer for agriculture production.

For the investigation of attitude and acceptance of innovations in the operating farm household, the user or potential user (operating household and/or family head) stands in the center of interest. Its attitude and behavior of acceptance are essentially determined by the interceding variables (internal psychological structure). These result from the experiences and the information, which are based on the one hand on the interactions of the physical and social environment (ASTOR 1987: 37ff; DOPPLER 1991; LANGENHEDER 1975), and on the other hand are affected by the perceived attributes of the innovation (ADESINA A. ZINNAH 1993: 298).

As emphasized already, there is an amount of factors which influences attitudes and acceptance of new technology in wastewater management of integrated operating farm households. Their operationalization to be analyzed, is based on a broad literature review of worldwide experience in the use of biogas digester, modern latrines as well as in the introduction of new technology in agricultural households (GUTTERER 1997; FEDER 1984; FEDER, JUST, ZILBERMAN 1985; ASTOR 1987; KOSSMANN A. PÖNITZ 1999; MUKHERJEE 2001; ADCOM 2002; BUI, PRESTON, ET AL. 1997; KVARNSTRÖM A. PETERSENS 2003: 25).

The study was conducted in three selected communities of the Province Can Tho. The respondents were operating farm households categorized into users and non-users of biogas plants and modern latrines. The composition of attitude and acceptance analysis shall offer more profound results for recommendations to improve the introduction and further dissemination of new technology in water management and sanitation. In order to get more background information as well as information about upcoming questions several key-person interviews were accomplished.

#### **4.2.2 The Survey Instruments and their Derivation**

The influencing dimensions derive from the integrated approach, combining the theory of decision making behavior (LANGENHEDER 1975) with its basis on the classic, socio-psychological “Three-Component-Model” of ROSENBERG AND HOVLAND (FREY A. MÖHLE 1989: 135), the acceptance model of KOLLMAN (1998) as well as the model of farm systems in tropics and subtropics (DOPPLER 1991) already described.

According to the experiences of several studies about attitudes and acceptance of innovations in agricultural practices and households, the principal instrument of the investigation is a standardized questionnaire. Its basic structure is divided into “**Objective Surrounding**” and “**Attributes of Innovation**” (ADESINA A. SEIDI 1995: 358ff; ASTOR 1987: 37ff; FEDER, JUST, ZILBERMAN 1985: 257ff; PERUMAL A. MUTHUKRISHNAN 1983: 14f).

Due to the evaluation of numerous international studies also FEDER comes to the conclusion that not only the economic, but also the social, cultural and institutional environment as well as the interactions of the different factors must be particularly

analyzed, in order to be able to make more exact statements about the acceptance behavior of the operating farm households (FEDER 1984: 288).

Thus the objective surrounding of the operating farm household is characterized by several dimensions (economical, social, cultural, political, medical, and ecological) which include a selection of issues further described and defined below.

**Core-hypothesis:** Each of the six dimensions representing the objective surrounding of the operating farm household have high influence on its attitudes and acceptance behavior towards new technology.

### ***4.2.3 Determination of Dimensions Influencing the Operating Farm Households' Acceptance***

In the following paragraphs the main elements of each dimension (social, economical, cultural, political, medical and ecological) are explained. These selected elements are operationalized in the standardized questionnaire according to the aimed comparison of the User- and Non-User-OFHs.

#### **4.2.3.1 Social Dimension**

Society and technology are inseparable. The design and development, attitude and acceptance, utilization and diffusion of technology are inherently social processes. According to SEGAL (1994: 2) "all structures and machines, primitive or sophisticated, exist in a social context and, unless designed for the sake of design itself, serve a social function". Technology and society interact and influence each other. Thus technology impacts, shapes, and defines society and, in turn, a variety of social factors affect the development, implementation, and dissemination of technology (SURRY A. FARQUHAR 1996: 1). The analysis of the social dimension comprehends the socio-demographic as well as the socio-psychological aspects of the target group (ASTOR 1987: 39; RUNGE-METZGER 1990: 46f). The latter gets more emphasis in the second part of this study, concerning each innovation in detail. Consequently, the aspects to be analyzed under the social dimension are human capital, the households' living standard, labor and workload distribution, social interaction and principal means of information access, preservation and development of the OFHs' substance as well as the individualism referring to acceptance conditions.

With the analysis of the social dimension answers will be given to the following issues:

1. Description of the target group under demographic and social aspects to form part of a respondent's profile in the research area.
2. Description of social contacts and information transmission in close relation to the farmer's attitude and acceptance behavior to understand the ways of communication as well as for possible recommendations to enhance the rate of acceptance.

### **Human Capital**

In the socio-scientific context human capital is defined by the abilities and skills of a person based on its education (KUTSCH 2002: 263). In several surveys it is shown that the family size, the age of the household head as well as the level of education are important factors for attitudes and acceptance behavior (ADESINA A. SEIDI 1995: 362f; FEDER, JUST, ZILBERMAN 1985: 271; FEDER A. SLADE 1984: 318; BERTHOLD 1990: 10). Therefore in the presented study it is described by the size of the operating farm household as well as the age, sex, literacy and education of the household head as the decision making person.

↳ Working hypothesis: The higher the average human capital the higher the disposition for sustainable acceptance of innovations.

### **Living Standard**

Living standard is defined in the narrower sense referring to material prosperity to be distinguished from living quality (ENDRUWEIT 2003: 645ff). Nevertheless in Viet Nam it includes the used sanitary infrastructure because of the strongly water based life and the survey's overall topic. As living standard also includes an economic component, it has to be seen in close relation to aspects of the economic dimension like risk and uncertainty, too (FEDER, JUST, ZILBERMAN 1985: 262f). Further, in the sense of Maslow's pyramid of necessities it needs the person's satisfaction of basic necessities to be accessible for social and cultural aspects as environmental problems (DIERKES A. FIETKAU 1988: 26f; PIORKOWSKY 1997: 68). Consequently, the term living standard is composed of alimentation, land tenure, farmstead quality, household equipment as well as sanitary infrastructure.

↳ Working hypothesis: The higher the living standard, the higher the disposition for acceptance of innovations.

### **Labor / Workload**

Labor is a very important element in the operating farm household with a broad network to determinants of attitudes and acceptance behavior. It can be linked as far as from information access, compatibility and profit until rank of prestige (FEDER, JUST, ZILBERMAN 1985: 266f, 277f). In the social scope of the survey the disposition and distribution of labor in location, agricultural product and time are analyzed.

But labor is also part of the ease and willingness to use something as well as the economical aspect to save expenses. Both, savings in human labor as well as workload can be very valuable determinants for acceptance (KELLNER 1985: 12f; STÖHR A. WERNER 1985: 21ff). Thus a special focus is laid on the use of each innovation especially the use of mineral fertilizer in comparison to organic material (*cp. Chapter 4.2.4*).

- ↪ Working hypothesis: The higher the actual workload of the household members, the higher the disposition for acceptance of labor saving innovations.

### **Social Interaction and Information Access**

In the previously presented model of decision making (LANGENHEDER 1975) the sociological variables consist of “indirect communication” and “direct social interaction”. Especially in rural areas of developing countries the social interaction has high importance in everyday life (HIEBERT 1974: 767; FEDER A. SLADE 1984: 312, 318). ARNOLD (1997: 69) states that in most cases only few farmers acquire new information actively, whereas the rank and file behaves conservatively waiting for direct personal contacts. Thus, in this dimension the analysis focuses the descriptive level of information networks and is emphasized later in direct relation to each evaluated innovations. Additionally, some information like organizational structure at community level, extension service, etc. could be obtained through the secondary analysis and key-person interviews (LE, YAMADA ET AL. 2002: 103ff).

- ↪ Working hypothesis: The broader the available spectrum of social contacts, the better the access to information.

### **Preservation of the Operating Farm Household’s Substance**

This is an explorative part of the study. The principal problems perceived by the operating farm household and according to its situation the future plans or objectives will be assessed. The question of objectives and problems is directly related to the development of the operating farm household. As the innovation’s acceptance needs a continuance of an at least partly agricultural based household, this information is essential (DOPPLER 1991: 11). Further, it gives important background information about possible hidden constraints, lack of interest or unofficial restrictions.

- ↪ Working hypothesis: The more problems and objectives are mentioned which can be improved by the innovations, the higher the OFHs’ disposition for acceptance of those innovations.

### **Self-Interest and Individualism**

Self-interest, the human pursuit towards his self-advantage constitutes the motivating forces of economic life. Additionally, individualism is a concept, which emphasizes the interests, needs and rights of the individual in relation to its equalization with others. The individualism as social philosophical teachings explains the society as the bare sum of the relations between individuals (BERTHOLD 1990: 10).

In conclusion, this element tries to find out the person’s attitude towards the required conditions for acceptance of innovations in general by a selection of statements.



↪ Working hypothesis: The more the innovation's general conditions correspond to the self-interest of the potential user, the higher the disposition for their acceptance.

#### 4.2.3.2 Economical Dimension

The analysis of the economical dimension focuses with its key-elements capital, liquidity and credit on the financial evaluation of the operating farm households. A rough appraisal of the agricultural production is included as a back-up to the economic potential (DOPPLER 1991: 19f). Especially the livestock forms part of the income and might play an important role as collateral for raising credits. Additionally, the priority in agricultural production might be decisive for the sustainable acceptance of an innovation or the interlinked system, as the innovations are closely linked to agricultural activity. As all six dimensions, the economic one consists of a descriptive and clarifying part on household level; these aspects are analyzed in direct relation to the innovations.

Basically the following topics are subject of the research on the economical dimension:

1. Description of the target group under economic as well as agricultural production aspects.
2. Assessment of the relationship between financial possibilities and the attitudes and acceptance of the evaluated innovations.
3. Appraisal of credit conditions and experiences as a very important determinant for acceptance in suspected low-income households.

#### Capital

In terms of economics, capital is the value of the entire asset, which is divided into own funds and committed assets (KUTSCH 2002: 263). Here the term "capital" is defined exclusively as own funds. These are represented by income and cash savings of the operating farm household, which have direct impact on risk and uncertainty (FEDER 1980: 263f; RUNGE-METZGER 1990: 46f). Thereby the partition of income in its sources is a key factor. Since the economical point of view is supposed to have high relevance for acceptance behavior, explicit attention is given to further terms of "liquidity", "credits" and "agricultural production".

↪ Working hypothesis: The higher the available capital, the higher the disposition for acceptance of innovations.

#### Liquidity

In the conducted study it is impossible to analyze an exact cash flow on the household level. But at least some key markers can be analyzed. Thus, the information about allocation of own funds has to be relativized by seasonal and

permanent charges as well as monthly saving rates to get an estimation of the household's liquidity and possible differences between the two household groups.

↳ Working hypothesis: The higher the liquidity, the higher the disposition for investment in innovations by the operating farm household.

### **Credits**

The availability and access of credits is an important point for investment and thus, for acceptance of innovations. WÖRZ A. ENGEL (1998: 60ff) already describes the significance of credit programs for the rural development in Viet Nam. In many countries credit availability is proportional to the farmers' land tenure (FEDER, JUST, ZILBERMAN 1985: 262). That makes it almost impossible for poor and/or landless households to raise credit. Further, the allocation of credit can entail certain restrictions on input use (FEDER, JUST, ZILBERMAN 1985: 278f). These circumstances make credit conditions a key determinant for acceptance behavior and essential to analyze it in its whole extent (WOLZ 1998: 179ff). Recent research affords by ZELLER A MEYER (2002: 1ff) led to the concept of the "critical triangle of microfinance" that concerns the three issues of outreach (reaching poor households in quantity and quality), the impact (on the credit recipients' living standard) and the financial sustainability (long-term cost covering). Consequently, the access to information about credits, the conditions of raising credit as well as made experiences and opinions are worth to be evaluated.

↳ Working hypothesis: The better the conditions for raising credits, the higher the disposition for acceptance of innovations by the operating farm household.

### **Agricultural Production**

What are the necessities and possibilities of BGP use in terms of agricultural production and how are the farmers' attitudes concerning these aspects? According to the literature concerning the use of BGP in Viet Nam it indicates that the distribution of BGP was based on pig production (BUI, PRESTON, ET AL. 1997: 1ff; NGUYEN A. LE 2002: 1ff; KOSSMANN A. PÖNITZ 1999: 48f). The operating farm households' agricultural production will be analyzed by animal husbandry, agriculture and use of fertilizer as main aspects. The type and amount of owned animals represents a kind of livestock capital that is closely related to capital and credit issues. Additionally, fertilizer use and expenditures as well as the type of land-use are supposed to be important aspects for acceptance of the surveyed innovations.

↳ Working hypothesis: The more agricultural production is influenced positively by the use of innovations, the higher the disposition for acceptance of these innovations by the operating farm household.

### 4.2.3.3 Cultural Dimension

In the context of ecological sanitation the cultural dimension comprehends the exposure to water and garbage especially in reference to traditions and social acceptability (ASTOR 1987: 44ff). Even if BRUUN AND KALLAND (1995: 2f) mentioned that researchers of different scientific disciplines could not verify the assumption that Asian philosophies and cosmologies have a significant preventing effect on the principal environmental problems like overexploitation of soils, deforestation or water pollution as they are common in Viet Nam, too. The OFHs' exposure is closely related to the surrounding conditions of the household like climate, resources access, costs, law as well as the health and environmental pollution aspects. In addition, the social acceptability or sometimes-called compatibility is a key determinant of the innovations' level, especially with regard to organic material, sludge and feces (KELLNER 1985: 12f; KOSSMANN A. PÖNITZ 1999: 39f). The principal subjects of research in this dimension are:

1. Description of the used water resources according to the season and the type of water conditioning on household level.
2. Description of garbage disposal, treatment and use.

### Exposure to Water

The operating farm households' exposure to water is represented by the treatment, use and constraints of the different water resources in the dry and rainy season.

↪ Working hypothesis: If the operating farm households have special forms of exposure to water, then its knowledge is essential for the development of an appropriate innovation.

### Exposure to Garbage

The operating farm households' exposure to garbage explains possible treatments and use categorized in organic substrates and packages.

↪ Working hypothesis: If the operating farm households have special forms of exposure to garbage, then its knowledge is essential for the development of an appropriate innovation.

### 4.2.3.4 Political Dimension

The experience, especially of projects in development cooperation demonstrated the necessity of conformity in country and project policies for dynamic and sustainable development (MESSNER 2001: 15f; DOPPLER 1991: 16). Despite the dynamic development of Viet Nam under the programme of "Doi Moi" it is still a country with a communist party and a lot of leftover soviet-union bureaucracy (DIEHL 2002: 288ff). Thus, the typical structure of mass organizations together with the governmental

institutions is supposed to have a strong influence on the households' attitudes and acceptance of innovations. In this regard, the emphasis is put on the two issues of the NRWSS, to ban the fishpond-latrine and to avoid the use of untreated human feces (MARD A. MOC 2000: 38).

With the survey on the political dimension the following topics will be clarified:

1. Description of the basic political, institutional network on community level.
2. Assessment of the political influence on health and sanitary infrastructure.
3. Assessment of the political influence on environmental pollution and use of garbage, especially organic material for agriculture.

### **Political Institutions as Policy Makers**

Among this scope basic information about membership and function of the household members in the communist party and the numerous mass organizations on community level will be collected. Especially in communist and former communist countries like Viet Nam the political network of institutions including mass organizations are directly related to the local government maintaining their importance for information access and influence on decision-making (PAYER 1998: 3ff).

↳ Working hypothesis: The more initiative the operating farm household shows in political institutions, the better the access to information and resources of innovations supported by the government.

### **Promotion of Innovations by Law, Regulations or Development Plan**

This point includes the analysis of the information process and people's awareness especially on the governmental intention to eliminate the "fishpond-latrine" by law (Decree No. 36 CT/TW dated June 25<sup>th</sup>, 1998) and to promote the use of organic fertilizer instead of untreated feces.

↳ Working hypothesis: The more coherent the impact of innovations to law, regulations and the national development policies, the higher the disposition for acceptance of these innovations by the operating farm household.

### **4.2.3.5 Medical Dimension**

The principal objective of sanitation is to protect and promote human health. Therefore, an integrated approach of acceptance analysis of innovations in substrate recycling of ecological sanitation, the medical dimension plays an important role and needs to be considered (ASTOR 1987: 43f; KVARNSTRÖM A. PETERSENS 2003: 18). Due to the hygienic situation and results of the exposure to water and garbage, it is directly linked with the cultural dimension. In an assessment of possible criteria for ecological sanitation KVARNSTRÖM AND PETERSENS (2003: 25) found out that the

hygienic improvement of people's living conditions is ranked as key aspect for positive decision-making, before the criteria of environmental protection and economy.

In the performed study, two aspects stand in the center of interest. The health care situation as well as the hygienic awareness of the operating farm household is selected as key element of research. Furthermore, the OFH's appraisal of the sanitization effect of BGP and ML for the use of feces will be assessed in the direct context of innovations. The objectives of this analysis are:

1. Basic description and appraisal of the health care situation.
2. Assessment of the hygienic awareness.

### **Health Care**

Here the term health care is limited to the farm households' efforts of accessibility, costs and opinions about these factors.

↪ Working hypothesis: The higher the efforts and costs for access of health care, the higher the disposition for acceptance of innovations which prevent diseases.

### **Hygienic Awareness**

Hygienic awareness is structured according to the "Three-Component-Model" of attitude into the scopes of hygienic relevant knowledge, attitudes towards hygienic conditions and the disposition of hygienic commitments.

↪ Working hypothesis: The more frequently waterborne infections occur among the household members, the higher the interest to use innovations which reduce these infections.

#### **4.2.3.6 Ecological Dimension**

In the conducted study the ecological dimension is linked especially to the cultural political and medical dimension for an integrated approach on acceptance analysis of innovations in ecological sanitation (ASTOR 1987: 43f). The completing information about the awareness of ecological problems, specifically referring to water and garbage, is supposed to be necessary for the analysis on BGS-use. Considering the innovations' acceptance it is important to analyze if the User-OFHs show higher environmental awareness as well as according commitments, and if the latter stand in relation with BGP and/or ML-use. The principal subjects of research in this dimension are:

1. Description of garbage disposal, treatment and use.
2. Assessment of environmental awareness.

### **Environmental Awareness**

Environmental awareness is a theoretical composition, which generates from the dimensions environmental relevant awareness, the environmental focused attitude and the disposition of environmental commitment (Urban 1986: 363). As it is organized according to the “Three-Component-Model” of attitude (KROEBER-RIEL A. WEINBERG 1996: 169f) this structure is also kept for the respective data collection.

↳ Working hypothesis: Operating farm households with high environmental awareness are more likely disposed to accept the innovations.

#### ***4.2.4 Determination of Attributes of Innovation Influencing the Operating Farm Households' Acceptance***

In the past, most approaches to determine and explain the factors affecting the acceptance behavior on innovations focus on one or more of the above mentioned dimensions. But the majority ignored the intervenient factors, the subjective assessments of the innovations' attributes by the farmer. ADESINA A. ZINNAH (1993: 298) emphasize that the perception of the innovations' attributes have important influence on the acceptance behavior. These empirical results are consistent with the theoretical approach of human decision making (LANGENHEDER 1975: 65f) as well as with the 'Three-Component-Model' of attitudes (KROEBER-RIEL A. WEINBERG 1996: 169f).

Consequently, a second part of the present study concentrates on the attributes of innovations. These are organized according to the evaluated innovation and are structured each in various subjects referring to the above dimensions.

**Core-hypothesis:** The attributes of each innovation and their perceived value have important influence on attitudes and acceptance behavior of the operating farm household.

##### **4.2.4.1 Attributes of Biogas Plant (BGP)**

According to literature review the use of biogas plants is predominantly seen under the aspect of renewable energy and thus, the production of biogas (GUTTERER 1997: 129ff). The value of effluent and biogas sludge (BGS) is scientifically established but in most cases their acceptance to use is denied because of its consistency and therefore its transport as long as it is not dried. But according to field experiments, the dried material loses part of its nutrient value. The lack of information about its efficiency and potential of mineral fertilizer substitution are not given. Furthermore, frequently reported constraints of BGP acceptance are the initial costs (credit access), cultural compatibility, lack of space and livestock, increasing workload,

complexity of technology, etc. (DEMANT 1990: 22ff; KOSSMANN A. PÖNITZ 1999a: 26ff, 35ff; SASSE 1990: 24f; PERUMAL A. MUTHUKRISHNAN 1983: 14ff).

Apart from a description of the biogas status quo in the research area, this section of the research concept concentrates on the analysis of attitude towards and acceptance of biogas plants from the Users' and Non-Users' point of view. This includes motives, reasons and constraints related to investment, use, utility as well as the consideration of aspects based on the six dimensions described before.

**Leading-hypothesis:** For the determination of attitude and acceptance factors to use BGP a holistic assessment is necessary.

### **Basic Characteristics**

This subject involves exclusively operating farm households which possess BGPs. Information is required about the BGP type, the financing, the information channels and aspects of use. Additionally, key-person information allows the description of BGP management and its status quo in the surveyed communities.

↳ **Working hypothesis:** The more exact the information about the existing infrastructure of the analyzed innovation, the better acceptance behavior can be evaluated in relation to other factors.

### **Motives / Reasons for Investment and Use**

The term "relative advantage" may include aspects like efficiency, profitability, perceived usefulness as well as hygienic impact. In literature concerning attitudes and acceptance behavior of both, agricultural innovations and in particular biogas plants, there is neither a fixed selection of aspects nor an equal definition of those (DAVIS 1989: 320f). However, regarding BGP acceptance probable motives are the new energy resource in terms of biogas and therefore financial savings, the substitution of firewood leading to less workload. Referring to this, improved comfort (no smoke and grime in the kitchen) and hygienic conditions are commonly mentioned as motives to invest in BGP (GUTTERER 1997: 131f; PERUMAL A. MUTHUKRISHNAN 1983: 14ff; DUONG 2002: 5).

Very similar to the definition of complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use" by ROGERS AND SHOEMAKER (1971: 154) is the described "perceived ease of use" by DAVIS (1989: 320f). His theoretical foundations for acceptance base on the perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort" as well as the perceived usefulness defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (DAVIS 1989: 320f).

PERUMAL A. MUTHUKRISHNAN (1983: 15) divide their concept of efficiency into three main aspects. It is understood in terms of time, labor and cost saving issues.

However, profitability involves the aspects of amortization as well as the perceived economic usefulness. It is closely connected to the economical part of the term efficiency (PERUMAL A. MUTHUKRISHNAN 1983: 15).

DAVIS (1989: 322) states that compatibility; relative advantage and complexity have a very consistent significant relationship across a broad range of innovation types. But compatibility and relative advantage have both been dealt with so broadly that there can't be given one exact overall definition (DAVIS 1989: 322).

Last but not least, some of these factors can be motives or constraints for investment and use of an innovation, depending on the direction of their parameter value.

In conclusion, the appraisal of BGP according to the model, cost and workload savings, improvement of work and hygiene conditions, ease of use including technical assistance as well as ecological impacts are going to be evaluated. They represent the scopes of possible motives or reasons for the investment and use of BGPs. Particularly, in descriptive studies explorative approaches are appropriate. They are the target-oriented search for cognition of an object or behavior towards an object (FRIEDRICHS 1990: 121f). Consequently, this part of the survey combines an explorative approach with assessments on issues based on the secondary analysis. In addition, the respondent's appraisal of reasons or opinions he thinks, the others have concerning the acceptance of BGP is asked. These mutual estimated attitudes probably bear information in the sense of AJZEN A. FISHBEIN'S pressure of expectancies and social norms in the community (*Chapter 4.1.1*). Expectance pressure of third parties and social norms can be driving forces as well as killing factors for person's decision-making process to use an innovation.

↳ Working hypothesis: The more explicit and consistent the information about motives for investment and use of BGP, the better to define determinants for acceptance for the BGP.

### **Constraints for Investment and Use**

This unit also needs a partially explorative approach. The key points like basic requirements (capital/credit, space, animal production), maintenance (costs, access of materials, technical assistance), satisfaction of products (gas and slurry) as well as possible additional workload is assessed by given statements and explorative edited questions.

↳ Working hypothesis: The more explicit the BGP's constraints of investment and use, the less the disposition of acceptance for the BGP.

### **Acceptability / Social Compatibility**

The acceptability can be regarded as a preliminary stage of acceptance, in the sense of the socio-cultural adaptation. Acceptability of an innovation is given only if it does not violate the basic values of the user and its social surroundings (SIMON 2001: 98).



It has to be appropriate to the practiced religion, ethics and traditions (PERUMAL A. MUTHUKRISHNAN 1983: 15f; DOPPLER 1991: 15). In this section BGP acceptability is analyzed by overall disposition for utilization, aversion of handling and the estimated prestige in sense of preservation or increase of social rank (PAYER 1998: 4).

↳ Working hypothesis: The influence of socio-cultural acceptability on the acceptance to use BGPs is supposed to be low.

#### 4.2.4.2 Attributes of Modern Latrines (ML)

The improvement of the sanitary infrastructure is a necessity with increasing importance for hygienic conditions. Hence the reinfection cycle of waterborne diseases could be broken if modern latrines would be connected to BGPs (THEILEN 1990: 16f). Two key-studies concerning sanitary infrastructure in South-East Asia (ADCOM 2002) and Viet Nam (MUKHERJEE 2001) as well as the compendiums of FEACHEM, BRADLEY ET AL. (1983: 67f, 117ff) and KVARNSTRÖM AND PETERSENS (2003: 25) on health aspects of excreta and wastewater management/ecological sanitation build the platform for the selected aspects, factors and formulation of hypothesis. Principal aspects are the hygienic improvement of living conditions, environmental protection, water and nutrient recycling, households' economy, reliability and assistance. Furthermore, user aspects regarding comfort, security and socio-cultural appropriateness in construction issues (e.g. opportunity to use feces) were analyzed to be important criteria. Due to the surveys the sanitation/hygienic awareness, economic prosperity and habit of open-air defecation were the most important aspects (ADCOM 2002: 8ff; MUKHERJEE 2001: 14f). However, the results varied and it has to be considered that these studies are restricted to communities of North Viet Nam or even other countries and therefore require a partially explorative approach in the Mekong Delta. Nevertheless, many features are similar to those for BGPs and have the same theoretical background.

Leading-hypothesis: For the determination of attitude and acceptance factors to use Modern Latrines and their connection at BGP a holistic assessment is necessary.

#### Basic Characteristics

Reliable information about the sanitation coverage in the research sites was not available. Therefore, this aspect involves all operating farm households in order to analyze the possession of different latrine types. This gives a rough overview about the sanitary infrastructure, the information access and status quo about sanitation as well as the present financing and management of ML in the research communities.

- ↪ Working hypothesis: The more exact the information about the existing infrastructure of the analyzed innovation, the better acceptance behavior can be evaluated in relation to other factors.

### **Motives / Reasons for Investment, Use and Connection of ML at BGP**

The objective to obtain information for an improvement of the sanitary infrastructure in combination with the BGP is realized by the assessment of key-factors for investment combined with the appraisal of construction characteristics and location of ML. Thus, attitudes according to the ease of use, usefulness as well as comfort are of centric significance. Further, the information network for demonstration and possible imitation effect according to LANGENHEDER'S (1975) approach is evaluated.

- ↪ Working hypothesis: The more explicit the motives for investment use and connection the higher the disposition for acceptance.

### **Constraints for Investment, Use and Connection of ML**

Under this issue the key points like basic requirements (capital/credit, space, and animal production), maintenance of the innovation (costs, access of materials, technical assistance), satisfaction of products (gas and slurry) as well as possible additional workload is assessed.

- ↪ Working hypothesis: The more explicit the ML's constraints of investment and use and connection, the less the disposition of acceptance for ML.

### **Acceptability / Social Compatibility**

The disposition for utilization, comfort and prestige are the key-points to be evaluated. Prestige in the sense of social compatibility may be a very important and complex factor. MUKHERJEE (2002: 12) mentioned that the desire to appear modern, save face with guests and get respect from neighbors is an influencing factor. As in the case of BGP, also for ML the person's appraisal of reasons or opinions he thinks, the oppositional OFH-group has concerning the ML acceptance, will be analyzed. The mutual estimated attitudes give an insight of the OFHs' expectancies and social norms in the community.

- ↪ Working hypothesis: The influence of socio-cultural acceptability on the acceptance to use MLs is supposed to be high.

#### **4.2.4.3 Attributes of Organic Material (OM) / Biogas Sludge (BGS)**

Biogas sludge produced by animal dung and/or human feces in biogas plants is a valuable organic fertilizer (WINBLAD A. SIMPSON-HÉRBERT 2004: 71ff). The quality respective to the composition of plant nutrients depends particularly on the substrate input (GUTTERER 1997: 39f). Hence it can substitute, to a certain degree, mineral

fertilizer. Additionally, the organic fertilization improves the humus content of the soil, which is a key-factor in preserving soil fertility (DEMANT 1990: 22ff). Secondly, the feces use for biogas production is supposed to have an important hygienic impact as during the fermentation process hygienic conditions are improved by elimination of pathogens (GUTTERER 1997: 40; THEILEN 1990: 17; FEACHEM, BRADLEY ET AL. 1983: 67f).

Nevertheless, the results of the secondary analysis and conducted pilot study point to the fact that an efficient use of anaerobic sludge by the operating farm households is unlikely (GUTTERER 1997: 132f; BUI 1997: 1, 8; DUONG 2002: 6). Major reasons mentioned are the lack of information about its efficiency and therefore calculation of substitution-rate for mineral fertilizer (economic inducement), problematic application (transport) specifically if not dried, bad odor, disgust (especially in case of including human feces). Among these aspects the difficult transport of liquid BGS is reported as killing factor for the step from "Pioneers" to "Early Adopters" and the following adopter groups (GUTTERER 1997: 133).

Objective is to assess the acceptability to use organic material, especially biogas sludge out of animal and human feces as fertilizer for agriculture and to evaluate factors of consumption of BGS produced products. Further, the alternative of earthworm breeding as process of substrate quality improvement and thereby enhancement of BGS acceptance is surveyed.

**Leading-hypothesis:** For the determination of attitude and acceptance factors to use Organic Material, especially BGS on human feces base, as fertilizer for agricultural production a holistic assessment is necessary.

### **Situation of Organic Material**

Organic material in general and its treatment or use according to type of agricultural production in comparison to use of mineral fertilizer and BGS will be described. This subject involves principally all OFHs and in some cases the OFHs with experiences in BGS use.

↪ **Working hypothesis:** The more exact the knowledge about the information access and actual use of the organic substrates, the better it can be evaluated in relation to other factors.

### **Motives / Reasons for Investment and Use**

What is the level of information and thus the attitudes or even experiences towards the use of biogas sludge? How is the farmers' appraisal of the possible hygienic impact? Apart from the economic advantage by substitution of mineral fertilizer also aspects of the medical, ecological and social dimension are evaluated.

↪ **Working hypothesis:** The more explicit the motives to use biogas sludge, the higher the disposition for its acceptance.

### **Constraints for Investment and Use**

According to the literature review, constraints from the user side seem to be located particularly in the scope of ease of use that includes the social compatibility, additional workload as well as technical constraints like texture, storage and transport.

↪ Working hypothesis: The more explicit the constraints for investment and use of biogas sludge, the less the disposition of acceptance for biogas sludge.

### **Acceptability / Social Compatibility**

In the present dimension the emphasis lies on the acceptability of using animal and human feces to produce biogas sludge for fertilizing agricultural cultivation (KOSSMANN A. PÖNITZ 1999a: 39f). The innovation's (biogas sludge) acceptability is analyzed by the households' doubts to consume foods which production is based on biogas sludge, assessment of socio-cultural handling constraints, ease of use, appraisal of objective attributes as well as the estimated social compatibility in meaning of prestige accordance (MARCHAIM 1992: 5; FEACHEM, BRADLEY ET AL. 1983: 118, 123).

↪ Working hypothesis: The higher the knowledge about the requirements for cultural acceptability to use biogas sludge, the more successful the development of an appropriate innovation.

### **Alternatives**

In the scope of possible alternatives the focus is on a comparison of organic and mineral fertilizer in selected aspects. Actually BGS is the alternative to the established use of mineral fertilizer. But due to the point of view to evaluate BGS acceptance the roles are set vice versa. Furthermore the basic analysis of earthworm breeding (EWB) is included, which is not necessarily an alternative but also an ongoing process for product improvement in the sense of quality and economic value. The additional objective consists of gaining information about knowledge, value and possibilities of earthworm breeding as a practice which finally could also improve the acceptance to use a BGP or even the complete system.

↪ Working hypothesis: The more competitive and valuable the "alternative" mineral fertilizer, the less the disposition for acceptance of the analyzed innovation.

↪ Working hypothesis: The higher the perceived advantage of earthworm breeding to improve BGS value, the higher the disposition for acceptance of the analyzed innovation.

### **4.2.5 Instruments for Data Collection**

#### **Structure of the farm household questionnaire**

A structured and standardized questionnaire including a selection of explorative formulated questions was used for the performed survey. According to the main farm household groups and thematic dimensions the questionnaire was organized in the seven subsequent modules.

#### ***Module A1 The Six Dimensions Concerning All OFHs***

This is the introductory module with simple questions about household composition, education, housing characteristics, land tenure, agricultural production as well as general questions concerning objectives and constraints of the household, access to information, attitude towards innovations, etc. It is to be answered by all farm household groups.

#### ***Module B Biogas Plant User***

Module B asks in-depth questions on farmers' attitudes and acceptance concerning acquisition and use of BGP, referring to model type, costs, workload, hygiene, compatibility, image, etc. The final question groups the farm households according to the used type of latrine.

#### ***Module C Biogas Plant Non-User***

This section aims at gaining information about attitudes of the BGP non-users. It contains a similar structure to Module B, but with the aim to elucidate non-acceptance.

#### ***Module D Modern Latrine User & Module E Traditional Latrine User***

These modules each are likewise structured as the two modules before but deal with the types of latrines.

#### ***Module F Organic Material***

Questions about the use of different types of organic material, especially biogas sludge are the focus of this module. Additionally basic information was collected about further processing on the basis of earthworm breeding.

#### ***Module A2 Finance***

This continuance of the first module (A1) concentrates on more sensitive topics like income, savings, debts and credit. At the end the possibility is given for free comments as well as the discussion of still untouched topics.

### **Photographical Catalogue of Interviewed Operating Farm Households**

The modern technology of digital cameras offers a very valuable instrument for the monitoring, reflection and further data processing. It can be seen as a modern type of non-participating observation (SCHNELL, HILL, ESSER 1995: 355f). During the fieldwork the author took pictures of all interviewed households as a supplement to the diary and daily reflection. The images were organized according to community, date, time and interviewer. By means of this photographic catalogue it is possible to review and compare data of each questionnaire with the taken images of the interviewed person, the household and its installations. Apart of that it offers an archive for presentations and publications.

### **Structure of the Interviewers' Reflection Sheets**

In survey methodology a continual reflection of the interviews is an important measure to achieving high quality data. As the interviews are realized in a team of Vietnamese interviewers organized by the author his introspection concerning the interviews needed to be supplemented by an introspection of each interviewer (SCHNELL, HILL, ESSER 1995: 357). Therefore, a reflection sheet was elaborated which had to be completed by the interviewers after finishing the interviews of each research site. Mainly the sheet asks for additional information to the key topics as well as own impressions of the situation in each community.

### **Guidelines for the Key-Person Interviews**

This type of interviews was realized in an explorative way and consequently structured guidelines were not elaborated (FRIEDRICHS 1990: 121ff). In fact, it was more useful to collect points of interest during the interview sessions, reflection hours with the interviewers and other discussions. Before the key-person interview these aspects were reviewed and kept in mind to get answers on the already identified issues but to be able to simultaneously enable an open dialogue and to get inspired by new aspects (Schnell, Hill, Esser 1995: 300f).

## ***4.2.6 Research Process and Methods of the Empirical Study***

### **4.2.6.1 Site Selection**

In *Chapter 3-4* the SANSED-Project was already described as an international research project in close cooperation of the Universities of Bonn, Bochum and Can Tho. The study in hand was realized within the SANSED-Project.

Thus the main research area was pre-selected by the Vietnamese colleagues and the German coordinator of the SANSED-Project according to criteria of all workgroups. There were several sites in Can Tho Province where the Center of Environmental Engineering and Renewable Energy (University of Can Tho) had done

research in recent years. To make logistics affordable it was necessary to stay in a one-day-journey distance to Can Tho City.


The most important factors for the selection of the communities of An Binh, Long Tuyen and Hoa An from the sociologist point of view were the following:

- ↪ Appearance of all household groups including different types of BGP and ML.
- ↪ Typical character of the communities concerning agricultural production and living standard representing the Mekong Delta.
- ↪ Transect of locations from suburban to rural area to have the possibility to acquire also information about differences and development according to the demographic gradient.
- ↪ Existence of contacts between communities and CTU to facilitate the acquisition of research permissions and thus the realization of fieldwork.

#### 4.2.6.2 Sample Selection

During the pilot-study information about the target population was collected. For the research on attitudes and acceptance behavior of three innovations constituting the wastewater system, it was necessary to select different kinds of households. Unfortunately the information of the three People's Committees about the amount of households using a BGP and/or a ML was very insecure. No complete rosters with the addresses, but only vague estimations existed. The possession of BGP was set as the principal criteria for the sampling. The criteria of ML as well as the organic material (BGS), treated as an innovation but at the same time as a product of one or both of the other two innovations, was left to simple random sample.

Consequently the 218 surveyed households were taken as a disproportional stratified sample in the three communities (SCHNELL, HILL, ESSER 1995: 253ff; FRIEDRICH 1990: 140). The realized interviews according to their location as well as to their type of household are shown in the table below (*Figure 4-6*). In fact no more households using BGPs could be found in none of the three communities. In the case of ML-User no information about the universe was available. Regarding the non-user households, the universe can be calculated by the number of households in each village (according data from PC) minus the user households respectively. Consequently, the non-user households' universe accounts approximately of 2,633 households in Long Tuyen, 3,160 households in An Binh and 3,207 households in Hoa An. The Non-User households were selected by random walk.

Location of interviewed Households	Household Varieties	Amount of Interviews planned	Amount of Interviews realized	User Groups			
				BGP	ML	SU	NU
Long Tuyen in 4 of 6 Hamlets	BGP + connected ML	14	7	7	7	7	
	BGP + ML not connected		3	3	3		
	BGP	20	9	9			
	ML		5		5		
	Non-user	30	41				41
	<b>Subtotal</b>	<b>64</b>	<b>65</b>	<b>19</b>	<b>15</b>	<b>7</b>	<b>41</b>
An Binh in 5 of 5 Hamlets	BGP + connected ML	30	10	10	9	10	
	BGP + ML not connected		23	23	23		
	BGP	15	19	19			
	ML		19		19		
	Non-user	30	18				18
	<b>Subtotal</b>	<b>75</b>	<b>89</b>	<b>52</b>	<b>51</b>	<b>10</b>	<b>18</b>
Hoa An in 7 of 14 Hamlets	BGP + connected ML	5	4	4	4	4	
	BGP + ML not connected		4	4	4		
	BGP	22	19	19			
	ML		2		2		
	Non-user	30	35				35
	<b>Subtotal</b>	<b>57</b>	<b>64</b>	<b>27</b>	<b>10</b>	<b>4</b>	<b>35</b>
	<b>TOTAL</b>	<b>196</b>	<b>218</b>	<b>98</b>	<b>76</b>	<b>21</b>	<b>94</b>
1. Hhs.-group: Biogas Plant-user (BGP) 2. Hhs.-group: Modern Latrine-user (ML)				3. Hhs.-group: System-user (SU) 4. Hhs.-group: Non-user (NU)		 9 ML + 1 fishpond latrine connected to BGP	

**Figure 4-6 : Sample of Principal Survey According to Location and Household Group**

#### 4.2.6.3 Organization of the fieldwork - Data Collection

##### Pilot-study

The first period in March/April 2003 started with the pilot workshop of SANSED-Project. All workgroups presented their objectives, plans and first results of the literature review. Afterwards the selection of the research sites was realized which was based on several fieldtrips and discussions together with all participants of the project.

During the following weeks the author got a closer view of the operating farm households in the three research sites by carrying out a pilot-study. In each of the three communities several operating farm households were visited for explorative interviews and inspections. This instrument gave an initial more detailed view of both, the different communities' characters and on the household level. Together with the information of the secondary analysis it formed the basis for the choice of methodology and its instrument development (FRIEDRICHS 1990: 112f). Besides it was very valuable to get an impression of the sites and living conditions during the end of the dry season, as the second stay was realized during the peak of the rainy season changing to the dry season. Together it made a good seasonal overview.



### **Interviewer Training and Pretest**

The intensive cooperation with the Vietnamese project partners of CTU was essential for the initial steps of investigation. The pilot-study, including detailed information on the people's committee annual report of the communities and in-depth secondary analysis made an elaboration of the questionnaire feasible. An opportunity was found to translate the questionnaire into South-Vietnamese language in Germany. Consequently the questionnaire could be tested immediately regarding translation, logical succession of questions, difficulties of understanding and its duration (ATTESLANDER 1995: 342ff; BORTZ 1984: 172ff).

The research team was composed of four graduated students with interview experiences, an agricultural background and basic knowledge of English language, who were contracted as interviewers for the whole time. During the first team-meeting the interviewers received an exemplar of the questionnaire as well as background information considering the survey. Until the second meeting the interviewers got the task to read the questionnaire and to make notes in case of understanding problems or other questions.

Hence in the second reunion the questionnaire was read loudly scrutinizing each question. After the agreement on the time table for the survey the interviewers had a couple of days left until the pretest date to get accustomed to the questionnaire by reading it themselves repeatedly.

At first, the pretest was planned to be carried out in the communities of An Binh and Long Tuyen. But the fact that the amount of households with biogas plants in Long Tuyen is very low and that the results in An Binh were very satisfying, reduced the pretest area on one community. Hoa An was not considered for the pretest because of its distant location from Can Tho University.

The pretest was accomplished at eight households on two consecutive days. Each interviewer had the possibility to carry out one interview in a household with and one without biogas plant. The interviewers were accompanied fulltime to monitor the problems as well as to help out immediately. Thus it served as an important part of the interviewers' training (SCHNELL, HILL, ESSER 1995: 325f). After each pretest session the problems mentioned by the interviewers themselves as well as the monitored constraints were discussed and solved together.

### **Realization of Interviews**

The principal survey was conducted between October and December 2003. The rainy season is supposed to be the best time to accomplish the interviews, as the farmers have finished harvesting and are forced by heavy rain to stay at home. From the logistical point of view this circumstances can be uncomfortable and sometimes difficult to access the households because of flooding. Since a research permission of each local government (People's Committee) was needed, the interviews were

implemented at one community after the other. In a first coordination meeting with the People's Committee (PC) the team got in contact with important representatives and could arrange local guides for each hamlet (community subdivision).

Good research contacts between the University of Can Tho and the Community of Long Tuyen and the contacts to the local guide had been established already, which made it the best starting point. Hence, the research team consisting of one or two local guides (local veterinaries, representatives of the Farmers' or Women's Union), the four contracted interviewers and the author himself worked together.

Every day two interview sessions, one in the morning and one in the afternoon, were conducted. Thus, eight interviews could be carried out per day. With the help of the PC and the local guides 218 households were visited by motorbike, foot and boat based on their location. The interviews took place in the proper farm household and had an average duration of about 1.5 to 2 hours. They were realized with the household head, who in most cases is the man. Generally, he has the right for final decision. But as in Viet Nam women are integrated by their husband in the process of decision making concerning especially sanitary and health care topics, their joint opinion to answer the questions was very much appreciated (ADCOM 2002: 20). During the survey's implementation in the three villages people were very friendly and hospitable, had time and patience, showed great interest in the subject matter and were open minded for further discussion and comments. The households were selected as already described in the paragraph "Sample Selection".

The interview procedure was the following: First of all one household per interviewer was chosen step by step. After that the guides had time to prepare the selection for the afternoon session or continued their everyday job. The author stayed with the last selected household. Thus he had the possibility to get an impression of the interviewed person and the household, to observe and take pictures for the photographical catalogue, to make some notes and to be available for possible questions and problem solving concerning the implementation of the interview. After some time he continued backwards to stay in the third, second and first selected household for the same reasons.

Altogether the people were very interested in the subject and eager to answer the questions without any hurry. Only in very few households the established introduction of the interviewer, subject and reason for the survey needed some more convincing explanations, that there was no sanitary control or tax charging background.

In the same way the operating farm households of the Communities An Binh and Hoa An were surveyed.

### **Realization of Interviewers' Reflection**

A short reflection of the interviews was done after each interview session on the basis of the questionnaire's revision. After completing the survey in a community the

four interviewers and the author sat together to discuss probable questions, problems and opinions. At the end of the meeting a so-called reflection sheet was handed out to each interviewer. On this base they had the opportunity to express their opinion due to the perceived information during the interview with regard to the major topics of BGP, ML and BGS use.

### **Realization of Key-person Interviews**

The key-person interviews were accomplished without any special rule or structure. During the whole research process in Viet Nam the author collected topics and special questions to be answered and got to know more and more interesting persons for a clarifying dialogue respectively. The range of the interviewed key-persons is broad as it was inspiring to talk to a local authority or the veterinary as well as to a scientist with experience in biogas technology or a representative of the local government and health care center. In total, the following key-person interviews were conducted:

- ↪ 3 interviews in the People's Committee of each research village realized by the author together with translator. Participants were the head of the PC, the Farmer's Union and the veterinary/extension officer.
- ↪ 1 interview with representatives of the Department of Planning and Investment of Can Tho Province.
- ↪ 1 interview with representatives of the Health Care Centre of Can Tho Province.
- ↪ 1 interview with the medical of An Binh Hospital.
- ↪ 1 interview with Mr. Khang, the principal representative of the Biogas Center, University of Agriculture and Forestry, Ho Chi Minh City in the cooperation project (FAO) to introduce BGP in Viet Nam, which started in 1992.

Additionally, numerous dialogues during the coordination meetings in the People's Committee, the University of Can Tho and with the colleagues of the other workgroups completed this part of data collection.

#### **4.2.6.4 Data Monitoring, Processing and Analysis**

In Viet Nam the first steps of data monitoring and processing took place. This was done mainly concerning technical and formal aspects. During the fieldwork in Viet Nam each questionnaire got examined after the respective interview session in the morning and afternoon to avoid mistakes and lack of data. According to a code plan all data of the questionnaires were entered into the program system SPSS<sup>17</sup> for statistic data analysis. For this step the generated responses of openly placed questions were categorized (BORTZ A. DOERING 1995: 273f; KIRCHHOFF ET AL. 2003: 44). During the basic counting the data in SPSS was reviewed, using the original questionnaires as well as the photographical base of each interview and household. For the further data evaluation uni- and bivariate analysis have been elaborated.

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17 SPSS is one of the most common computer based programmes for data analysis.

Apart from frequency counting, also particularly positional parameters, cross tables as well as factor and cluster analyses were used.

The information of the pre-study, the non-participating observations, the expert interviews as well as the interviewers' reflection sheets were used as background information, to clarify certain doubts and as instruments of reliability control (SCHNELL, HILL, ESSER 1995: 297ff).

Finally, it should be mentioned that no claim on statistic security of the numerical values and on representativeness is asserted. Rather, the gained results serve for tendency statements and should be understood accordingly. In this sense single values can only provide a disclosure of problem aspects. All quantitative data are to be always viewed with this background and with consciousness of the total sample size of 218 operating farm households.

## 5 Acceptance of New Technology for Wastewater Management in Small Scale Farming Systems

In this chapter the survey's results will be presented and analyzed. Therefore it is essential to know the basis on which the different parts of OFH will be presented. In the research concept (*cp. Figure 4-4*) an approach is followed to analyze separately the OFH-groups of users and non-users of innovations. *Figure 5-1* illustrates the various OFH-groups in an overview. According to the colors it is distinguished between the result blocks.

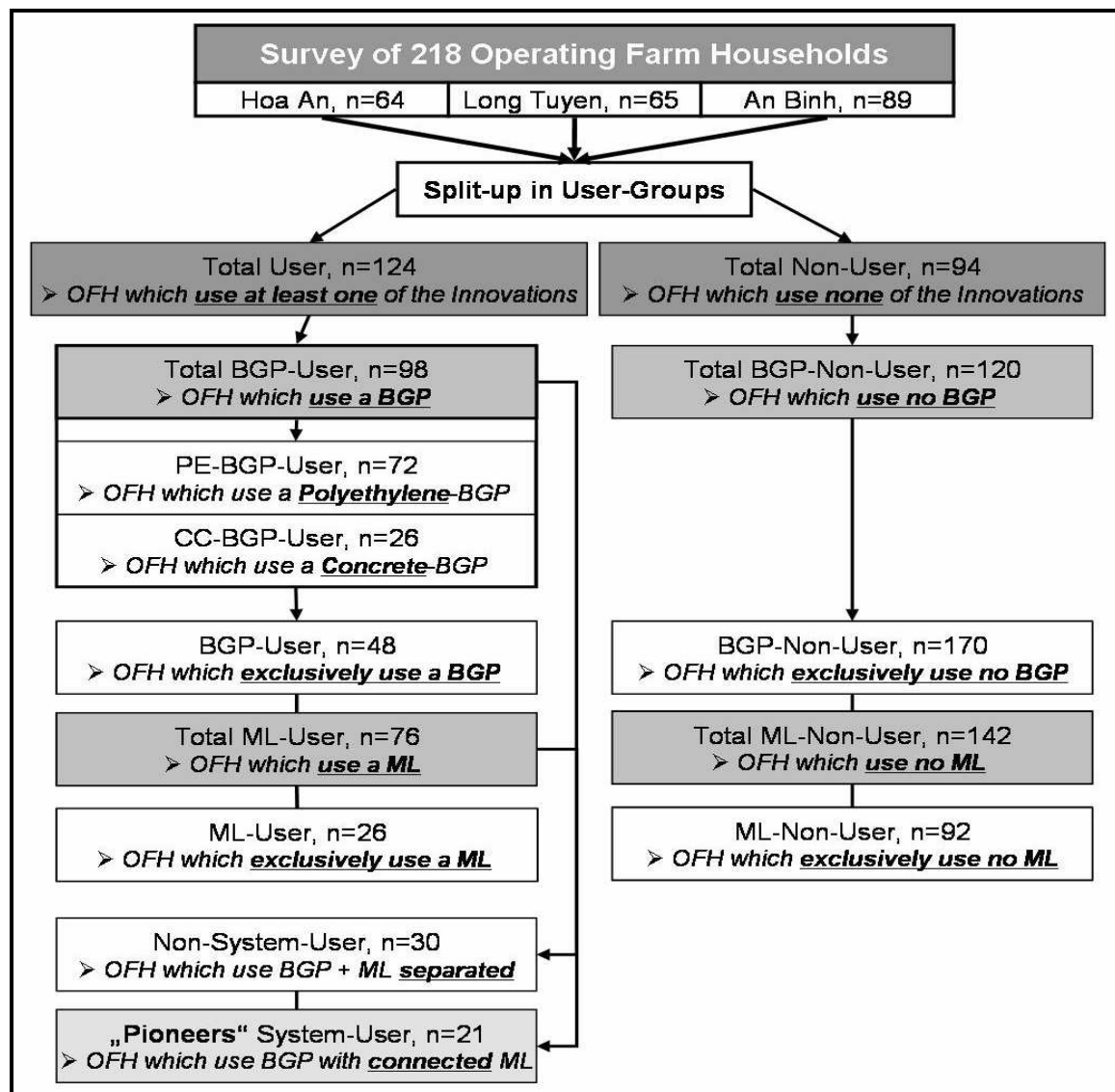


Figure 5-1 : Split-up of Survey Sample According to User-Groups<sup>18</sup>

As the overall objective is to clarify attitudes and acceptance of wastewater management in the scope of a treatment system that closes the substrate loop, BGP is the system's core element. Thus it was taken as the principal criteria for the sample selection. Nevertheless, ML is the second technological innovation and

<sup>18</sup> The 21 System-User include 1 OFH using a BGP with connected fishpond-latrine (*cp. Figure 4-6*).

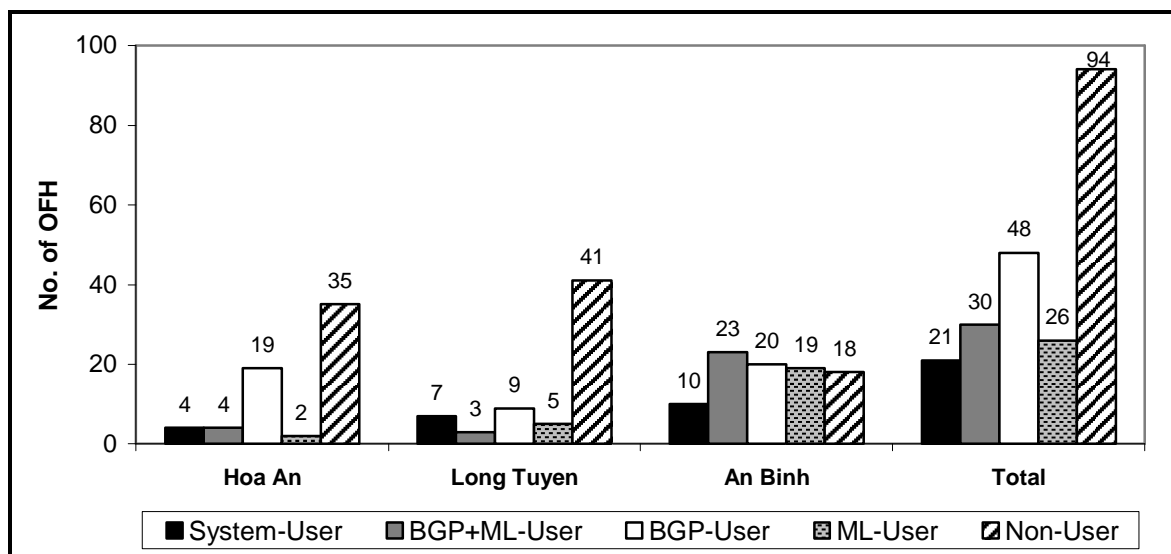
likewise indispensable for the system of ecological sanitation. Furthermore these two innovations produce BGS, which is considered as the third innovation of the substrate loop in the wastewater management system. Referring to this, particularly the farmers' attitudes and acceptance behavior towards BGS produced with human feces is a key aspect of this study. Due to these interests the six selected dimensions will be analyzed on the basis of the general user and non-user group (*cp. Chapter 4-1.6*). After that each innovation will be evaluated on basis of the smaller user and non-user groups.

### 5.1 Description of the Three Selected Research Sites

In the first step of result presentation the three surveyed communities will be described. Therefore data of the pre-study, including statistical data of the respective People's Committee and the information of the questionnaires as well as of the reflection sheets are used. Later in this chapter one's attention will be turned to important results between the household groups related to the community.

As the localization of the research area in the context of the Province Can Tho and the Mekong Delta in general has been presented already in *Chapter 2*, the following description of the three villages takes a closer look at their characteristics. Furthermore detailed statistics are illustrated among the analyzed dimensions.

First of all, the three villages can be distinguished according to their location like on a profile or scale from a rural to a suburban area. In this sense the village of Hoa An has absolute rural character. Long Tuyen also shows rural conditions, but due to its location it has some dynamics in suburban direction. Last but not least the village of An Binh is located between the boundary of Long Tuyen and Can Tho City (*cp. Appendix 2-2*). Hence, it is the bridge from rural to typical suburban area. *Figure 5-2* illustrates the sample split-up by surveyed villages.



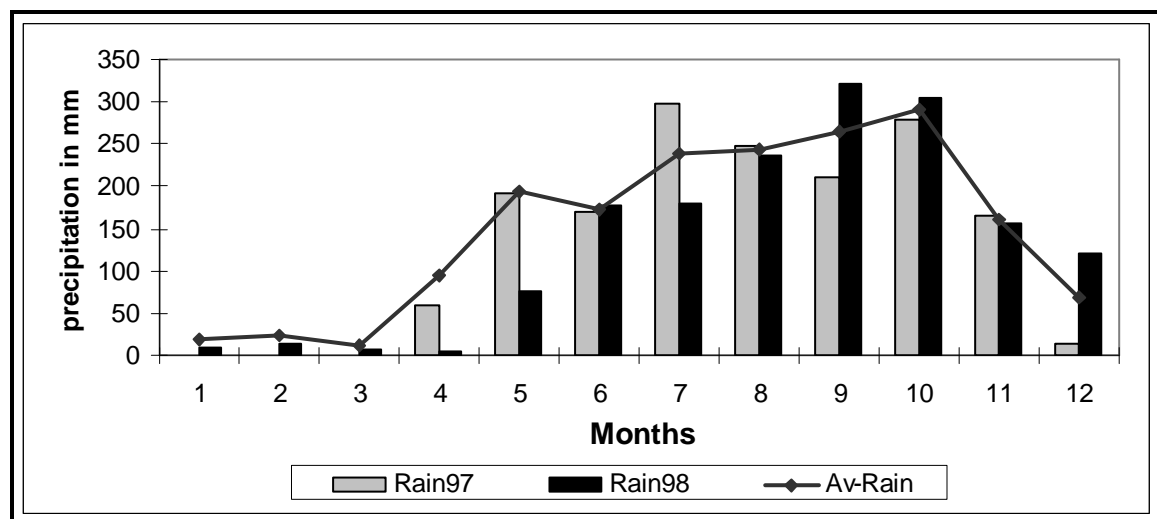
**Figure 5-2 : Survey Sample According to Research Sites and User Group (n=218)**

Different User-groups and their representation according to the villages are shown. It can be clearly seen that the OFHs of An Binh outnumber the other two research areas in presence of innovations as in Hoa An and Long Tuyen much less OFHs with BGP and in case of Hoa An also ML could be found.

### 5.1.1 The Village of Hoa An

The community of Hoa An is located at approximately 55 km in south-west direction from Can Tho City. It can be accessed by a paved road that gets narrower and worse with every kilometer heading southwest. Apart from the main road, there are no paved streets, which implicates that the households are rarely accessed by motorbike, but on foot using little pathways and “monkey-bridges”<sup>19</sup> as well as by boat on the numerous water channels, which is typical for the countryside of the Mekong Delta. Hoa An village was established in 1863 and has changed its name and community limits several times. Nowadays, the village belongs to Phung Hiep District and is composed of 14 hamlets with a total village area of about 5,000 ha of which two-thirds is agricultural used land. According to the information of the People’s Committee the total population accounts of 17,812 persons (3,236 households). The majority belongs to the ethnic group of Kinh, only 81 households are registered as Khmer or Chinese ethnic.

Due to the existence and activities of the CTU research station in Hoa An, climate data are available.



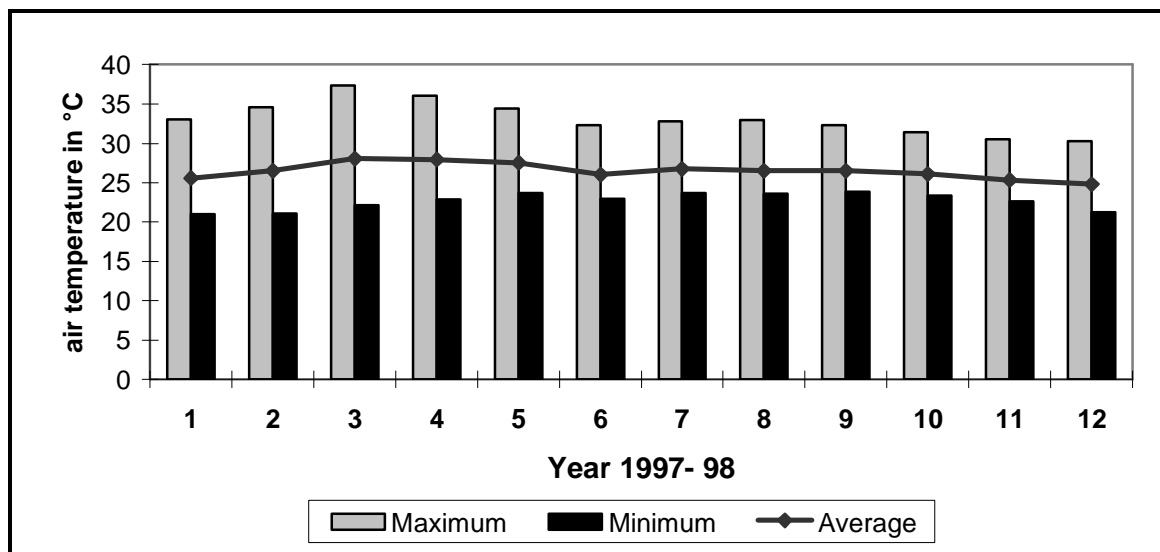
**Figure 5-3 : Precipitation at Hoa An Research Station in 1997/98 and Average Rainfall from 1991-1998** (Source: YAMASAKI A. DUONG 2000)

Figure 5-3 shows the average annual rainfall from 1991 to 1998 accounting of 1,785 mm in Hoa An. In the years 1997/98 the total precipitation reached 1,639 mm and

<sup>19</sup> The type of bridges represents an indicator appropriate to the overall village conditions. In the case of Hoa An most of the „monkey-bridges“ are very simple made by bamboo or other wood boles. In Long Tuyen this type still exists, but a big part is built out of wooden tables or concrete and thus passable with motorbikes. Consequently An Binh has got the whole range up to bigger bridges made out of steel, wooden planks or concrete for all type of motorized traffic (cp. Appendix 5-1).

1,605 mm respectively. The climatic conditions in Long Tuyen and An Binh are quite similar. During the rainy season from May until November almost the entire precipitation goes down. Thus, the principal flooding season occurs from September till November. In this period agricultural activities become difficult. Installations and buildings suffer, specifically in Hoa An, where the flooding can persist up to several month.

Figure 5-4 illustrates the air temperature at Hoa An research station with an average of 26 °C. The solar radiation is high from January to June and lower from July to December. The hottest period (high air temperature) is from March to April at the end of the dry season.



**Figure 5-4 : Air Temperature at Hoa An Research Station 1997/98**

(Source: Yamasaki a. Duong 2000)

Because of its location in a depressed area, Hoa An gets flooded in the rainy season for several months. In the scope of reclamation for intensive agricultural development in recent decades a network of canals was dug. Therefore Hoa An is connected to the Mekong River and the Gulf of Thailand by the main Cung Canal, which was dug in the 1930s under the French colonial rule.

At present, the area is poorly drained and is therefore affected annually by flooding to a maximum depth of about one meter from September to October. The floodwater recedes slowly compared to many other areas due to its location in a depression and the semi-diurnal tidal movement, which decreases water flow into the sea. In the course of the dry season, the water level in the field drops to a maximum of 60 cm below the soil surface. Due to increasing problems arising from acid sulfate soils and flooding, mainly paddy rice and sugarcane can be cultivated in the village.

YAMAZAKI A. DUONG (2000: 33ff) mention that the migration rates in two analyzed hamlets of Hoa An were rather high in the period of the survey from 1993 to 1997. Among the migrating people the majority owned little or no land. In household



economic terms the most difficult time of the year is the flood period from August to October as the principal labor source of agriculture is interrupted.

According to the People's Committee information 22 of the total of 3,236 OFHs owned a BGP and no information was received referring to ML-Users.

### ***5.1.2 The Village of Long Tuyen***

The village of Long Tuyen belongs to the District of Can Tho and is located 15 to 20 km from Can Tho City. The community area reaches 1,400 ha and a total of 12,933 inhabitants (2,657 households). The major ethnic groups are Kinh (about 97 %), the Khmer and the Hoa. Regarding the soil, loam predominates and varies from clay to sandy. Due to good soil conditions and drainage the agricultural production is mainly composed of fruit growing, rice cultivation, upland crops and aquaculture. The climatic conditions are similar to those of Hoa An.

Due to the vicinity to Can Tho City and its latest plans of infrastructure development, land prices have risen and farmers sell part of their land to invest in agricultural production as well as in new houses. Furthermore several organizations have been active in Long Tuyen to improve the living standard including installations of BGP and ML. According to the information of the People's Committee 34 OFHs are owners of a BGP and of those 14 OFHs dispose of a VACB system (cp. Chapter 3.3.1). Approximately 290 OFHs are using a ML with septic tank.

### ***5.1.3 The Village of An Binh***

An Binh village also belongs to the District of Can Tho and is located in between Can Tho City and the village of Long Tuyen. It is composed of the 5 hamlets Loi Du A, Loi Du B, Loi Nguyen A, Loi Nguyen B and Thoi Nhut. The whole community area accounts of 1,100 ha inhabited by 19,800 persons (3,231 households). An Binh is a typical suburban community. Thus, in general it can be said that the closer the hamlets to Can Tho City, the better the infrastructure, the smaller the family land tenure and the less farming activities. The average population density reaches here 1,800 persons/km<sup>2</sup> in comparison to Hoa An with 360 persons/km<sup>2</sup>. Some hamlets sit directly at the waterside of Can Tho River passing Can Tho City to meet Hau River. Thus, they have immediate access to the central markets of Can Tho.

Likewise Long Tuyen, the OFHs also dedicate their agricultural labors especially to fruit and rice production as well as aquaculture. The intensive fruit growing in both communities requires high amounts of fertilizer inputs. Climate and soil conditions are similar to those of Long Tuyen. According to information of the People's Committee about 150 OFHs should have PE-BGP and 15 CC-BGP; of those 5 OFHs use the BGP with connection of ML. Furthermore, around 1,600 households are supposed to have ML, principally with septic tank.

## **5.2 Social Dimension – Profile of the Respondent Operating Farm Households**

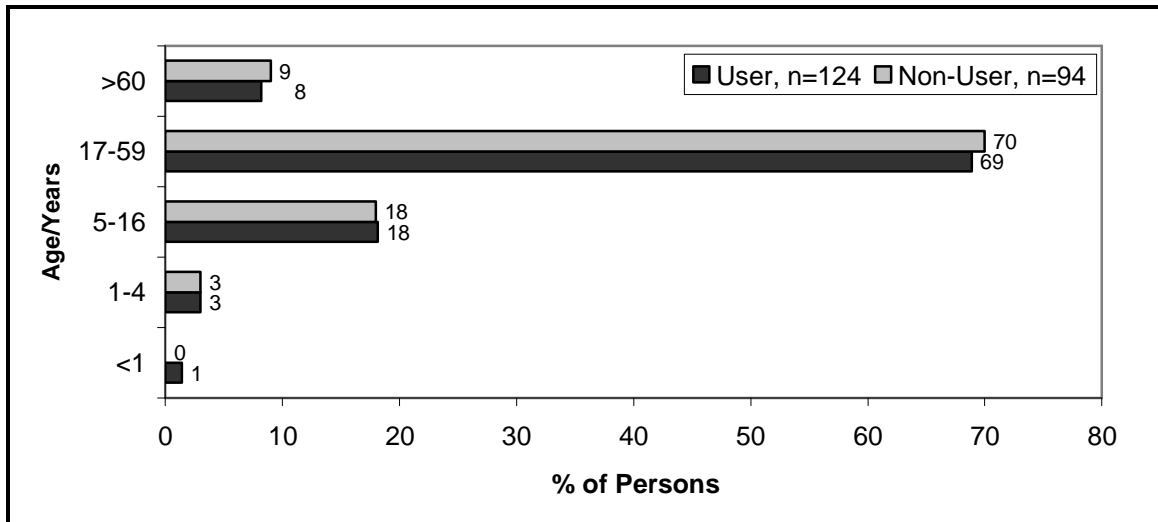
During the last decade, the national statistic (CIA 2004; WEGGEL 2001: 595f) demonstrates an important step forward to reduce the amount of poor families with a GDP per capita less than 150 USD, the percentage of children suffering from malnutrition (45-50 % in 1993) and thus to improve the living standard in general. Also the recently conducted participatory poverty assessment in the Mekong Delta states an improvement of livelihoods of the majority of people. Nevertheless, the amount of poor households is high, the disparity between rural and urban areas increases and the poorest households hardly have access to the improvements (UNDP A. AUSAID 2003: 1ff). Likewise, lack of education and poor sanitary infrastructure continue to be major problems, overall in the rural Viet Nam. In 1995 still more than 80 % of the population lived in unhygienic conditions due to lack of potable water supply and waste disposal systems (ICLARM 1996: 1f; IMF 2003:12ff). The social dimension is one of the most important and hence the most comprehensive one. The collected information about the social environment introduces the different OFH categories, describes the target group under demographic and social conditions and focuses on significant difference in context to the analyzed innovations.

### **5.2.1 Human Capital**

The demographic data of the respondent households showed that the average age of the respondents is 47.5 years in the age range from 18 to 79 years. Of the 218 respondents 143 were male household heads, 75 respondents were women of which two third were sole decision-makers in their household. Many households in An Binh are women headed due to high losses of young men during the war (ICLARM 2002: 11).

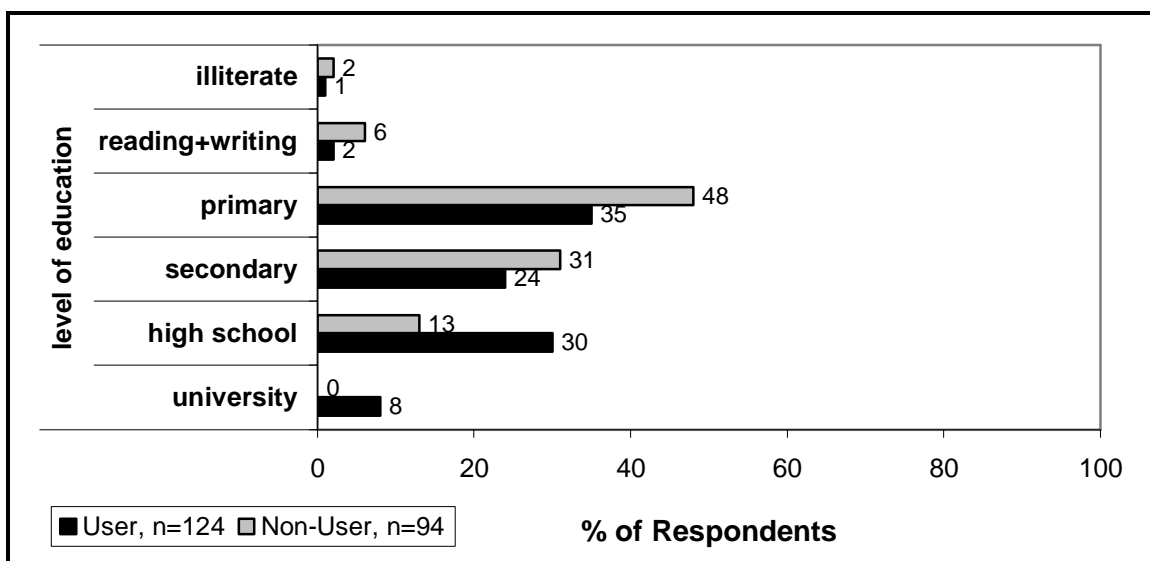
Concerning the total of 218 operating farm households selected by the study with 1,128 family members, the average family size adds up to 5.2 persons per household almost equally for both OFH-groups. It confirms the average household size of about 5 persons on provincial and regional levels. *Figure 5-5* shows the age structure of the surveyed households indicating middle to old age population. Observing the amount of children up to the age of 16 years, one gets the impression of a relatively low birthrate in the time since “Doi Moi” (end of the 80s) started as the country’s statistic accounts 15 % more for the same age category (GSO 2004, data from 1999; DAO 1995: 152f). In 1999 the General Statistics Office of Viet Nam (GSO) estimated an ageing population as the fertility rate continued to decline. Nevertheless, the estimation for the year 2004 accounts 30 % the population under 15 years and 62 % for 15-59 years (UNVN 1999: 40). Or, maybe a significant part of the younger generation is in the emigration process out of the countryside in order to receive

higher education and to find employment in urban areas. National statistics show a process of urbanization, although it is rather slow (UNVN 1999: 38f). A direct conclusion to one or a couple of factors cannot be drawn as the selected sample is small. But in case that this result would be representative for the Mekong Delta population, the decline of working population would point to a demographic problem in high workload based agriculture production society.



**Figure 5-5 : Population of Surveyed Operating Farm Households**

The demographic statistics do not vary much in consideration to the two household groups. Contrary to this, there are significant differences referring to the educational level. First of all, in comparison to other developing countries, the educational level is rather high, typical for a social communist republic (PAYER 1998: 3ff). *Figure 5-6* illustrates that over 90 % of both OFH groups attended primary school.

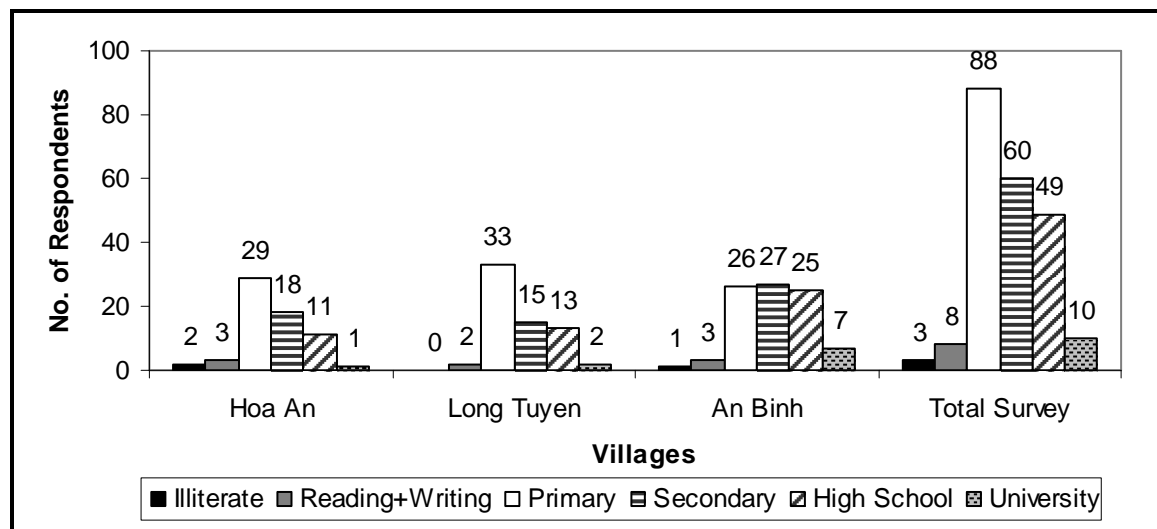


**Figure 5-6 : Users' and Non-Users' Educational Level**

These results match with the national statistics (literacy rate of 92 % in 1998) (UNVN 1999: 62). However, the figure indicates also very clearly the educational difference

between the two household groups. The users dominate significantly in the two highest educational levels of high school and university degree.

Due to the fact that the User-OFHs have a higher level of education, this feature was analyzed in detail (*Figure 5-7*) according to the three surveyed villages. The sample with the highest amount of User-OFH was taken in the suburban site of An Binh and consequently the discrepancy between the two rural sites and An Binh can be observed.



**Figure 5-7 : Educational Qualification of the Respondents in the Research Area (n=218)**

But this distribution of OFHs may be based on the suburban location, its easier access and not on the educational level or the living standard.

However, the village of An Binh accounts for the highest amount of User-OFHs and a higher educational level in comparison to the villages of Hoa An and Long Tuyen. It seems that the higher educational level plays, apart from others, an important role for the disposition for acceptance of innovations.

### **5.2.2 Living Standard**

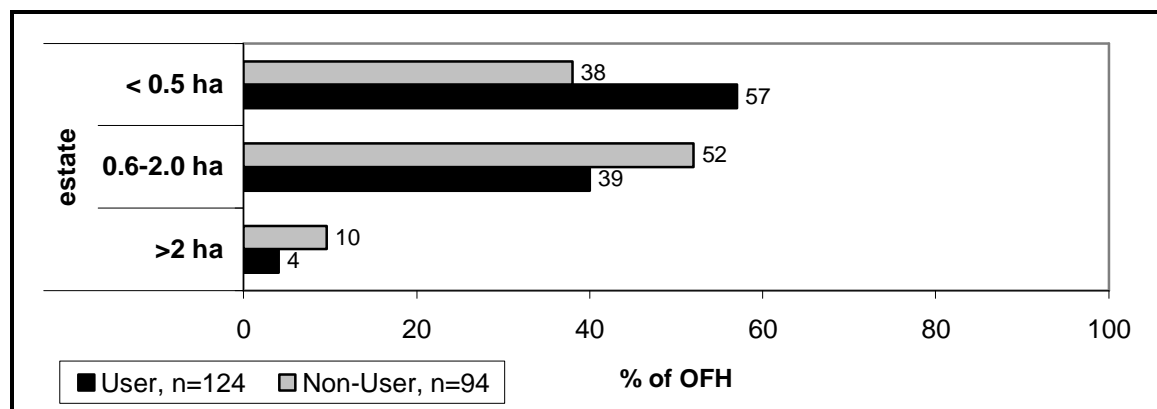
Living conditions of the farm households in the Mekong Delta are generally poor with one quarter of the population living in poverty. Further, 50 % of its population lives in very simple dwellings, about 80 % has no sanitary latrine and almost 50 % does not have access to safe water resources (WORLD BANK, DANIDA ET AL. 2003: 58; UNDP A. AUSAID 2003: 57f; GSO 2004).

The human basic need is sufficient access to food and water. The question concerning the food availability is very sensitive and was treated appropriately. All respondents answered the question. Nevertheless, in this issue it is possible that in some cases the persons were too ashamed or proud to admit their temporary critical situation. In total, only or even seven respondents mentioned to have lack of sufficient food availability for more than 3 months per year. Six of those were Non-

User-OFHs. One Non-User-OFH stated to have lack of sufficient food availability for 1-3 months per year. Although the Non-User-OFHs prevail in this aspect, the absolute amount is very low to draw conclusions. However, it can be seen as a first indicator for a lower living standard of the Non-User-OFHs.

In the year 2002 a local survey on food security in An Binh discovered that an average of 5 % had usually a food deficit and between 10 to 20 % of the OFHs had an occasional food deficit (ICLARM 2002: 24). Apart from the amount of affected OFHs, it is interesting to know that the peak time for food shortage in most cases meets the late flood season. Then, availability of agricultural products is low and farmers' activities get stuck which leads to income drop-out. So, people dedicate their time to other kinds of work or even have to travel seasonally in order to find employment (UNDP A. AUSAID 2003: 58f).

The average farm household in Viet Nam owns 0.5 ha and in the Mekong Delta about 1.0 ha agricultural land. According to the 1994 Agricultural Census less than 2 % of Viet Nam's farm households were landless (MINOT A. GOLETTI 2000: 12f). According to the information from Can Tho University, the amount of landless households increased from 0.7 % to more than 5 % in several Provinces of the Mekong Delta during the period from 1994 to 1998 (DE MAUNY A. HONG 1998: 31f). The imbalance of land ownership is considered getting bigger, creating a visible gap between the landless poor and richer land owners. Reasons for this development can be found in the dynamic population growth including the intensive migration process, especially in the Mekong Delta region (*cp. Chapter 2.4*). In *Figure 5-8*<sup>20</sup> it becomes apparent that in average Non-User-OFHs own more land.



**Figure 5-8 : Comparison of Users' and Non-Users' Real Estate Size**

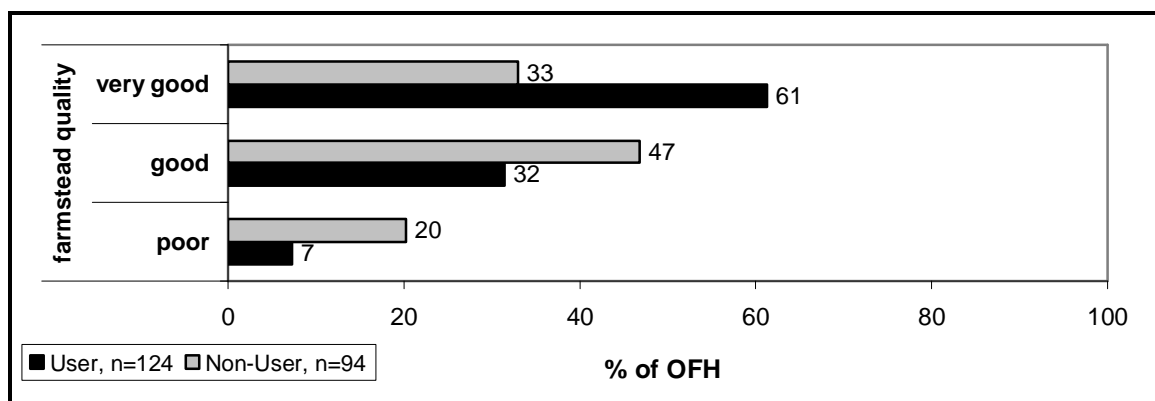
By comparison the average estate size of the examined OFHs adds up to 0.8 ha for the User-group and about 1.0 ha for the Non-User-group. In addition, of the 57 % of User-OFHs with less than 0.5 ha, even 34 % dispose of less than 0.3 ha land. This result can be explained by the distribution of User-OFHs and their different priority in

<sup>20</sup> In figures with percentage values it may occur to be summed to more than 100 % due to the disclaimer of decimal place.

land use. Specifically in Hoa An, the community with the highest amount of Non-User-OFHs, dominates clearly in cultivation of sugar cane and paddy, which require bigger land area than intensively used fishponds and fruit orchards in Long Tuyen and An Binh.

Consequently, it seems that OFHs with less estate use one of the innovations. Possibly the influence of ML dominates here. That means, OFHs, which do have neither much space nor a fishpond, probably decide to invest in a ML sooner than others. Thus, the lack of space and therefore the traditional solution of a fishpond-latrine, which becomes more difficult, compose a push factor to invest in ML. At least, regarding the distribution of surveyed OFHs with modern latrines indicates that two-thirds of ML-User households have less than 0.5 ha, 90 % of those located in suburban An Binh. This aspect of population pressure is congruent to the results of the study by MUKHERJEE (2001: 12f) and will continue to be analyzed in the chapter concerning ML (*cp. Chapter 5.9*).

Moreover, the quality of farmstead is a basic indicator to describe the existing living standard. In the interviews it was asked for the type of materials of the roof, walls and floor. Traditionally the houses of the rural Mekong Delta region are built with nipa palm or coconut leaves, bamboo and wooden poles and a condensed soil floor. The information was summarized and put into categories from poor to very good farmstead quality. Thereby the range is broad from poor conditioned traditional house to a brick built house with crystal windows and modern flagstones (*cp. Appendix 5-2*) *Figure 5-9* illustrates a significant deviation with the User-OFHs showing a majority in the upper farmstead quality.



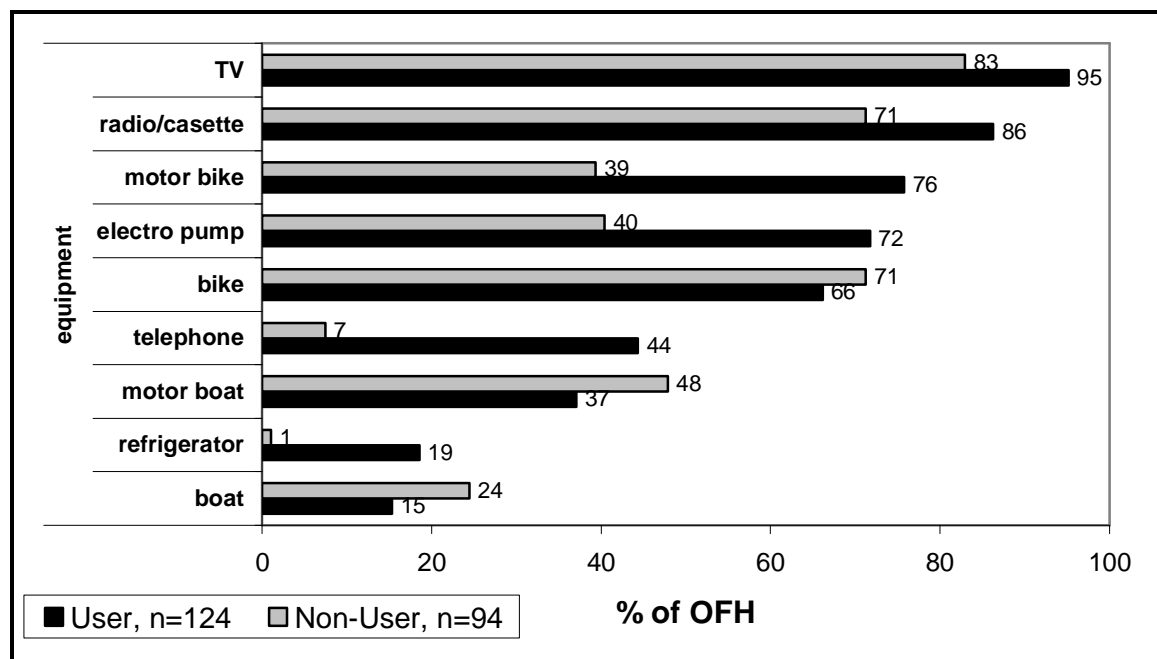
**Figure 5-9 : Comparison of Users' and Non-Users' Farmstead Quality**

The farmstead quality depends on the used construction material of the (1) roof, (2) wall and (3) floor. - **very good**: (1) metal/tiles, (2) bricks/concrete, (3) flagstones; **good**: other combination; **poor**: (1) leaves, (2) bamboo/wood, (3) soil

Apart from the general condition of farmsteads it can be stated that from suburban to rural area exists a perceivable bias (data not shown).

The ownership of household assets forms another important part for conclusions on living standard. *Figure 5-10* illustrates the distribution of an equipment selection. It is evident that the user-group is better featured. Particularly in case of motor bike and

electro pump as well as in luxury assets like telephone and refrigerator the living standard gap is obvious. Additionally, the figure shows the basic infrastructure availability for communication and information access (TV, radio, telephone), which is a further principal issue of the social dimension and hence, of the acceptance analysis. More than 80 % of both OFH-groups own a television and/or a radio. The ownership of a television can be seen as a core determinant. If a Vietnamese OFH has somehow enough savings for non-business issues, the principal equipment to be invested would be in a television. For that reason institutions on regional and local level use this media already to spread information on a broad variety of issues.

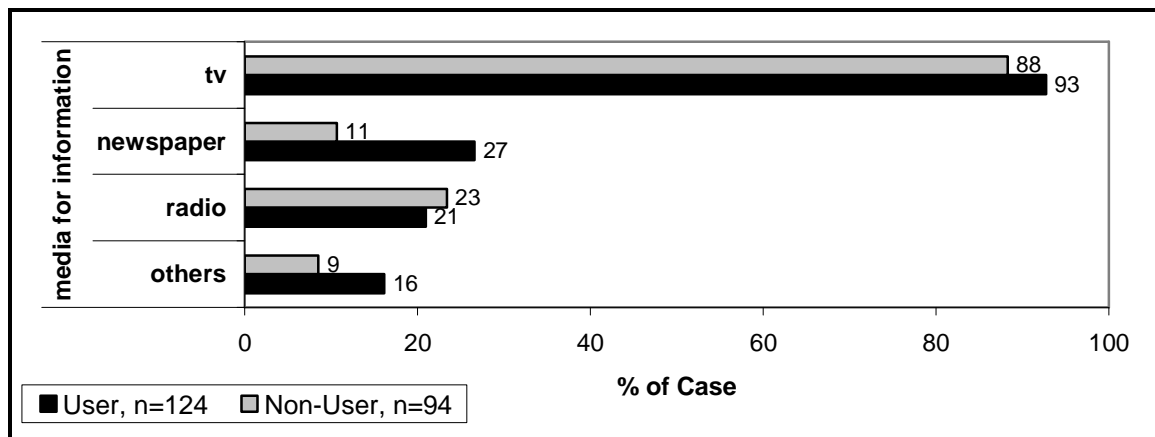


**Figure 5-10 : Comparison of Users' and Non-Users' Household Equipment**

Regarding the user-group differences in living standard, it can be assumed that the Non-User-OFHs in average have slightly bigger land tenure. But considering the direct living conditions as food availability, housing and household assets as well as sanitary infrastructure the User-OFHs dispose of a higher living standard level.

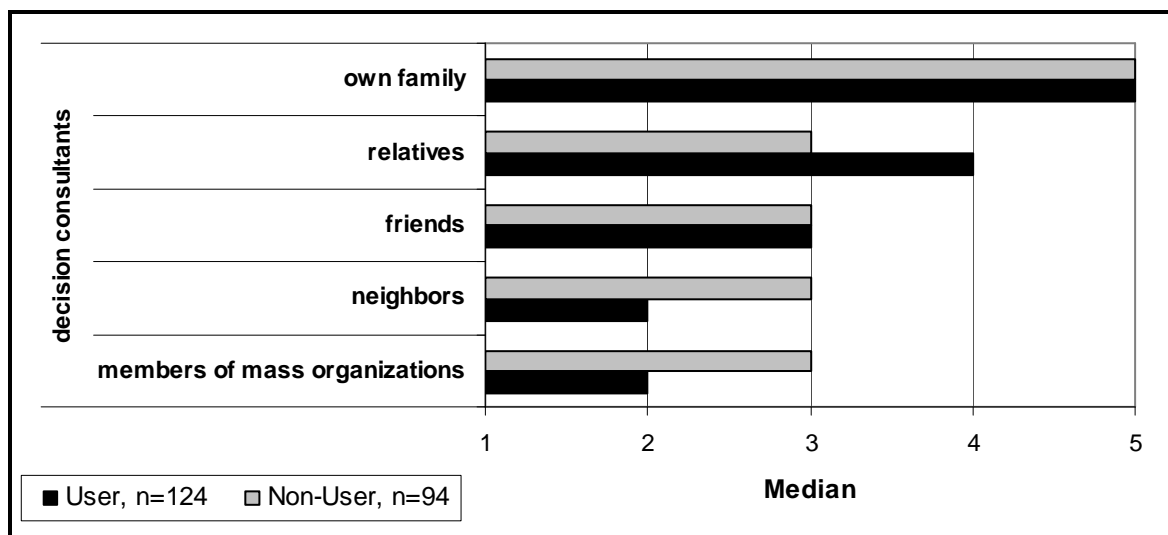
### **5.2.3 Social Interaction and Information Access**

Due to the fact that the social interaction with its varieties, channels and intensity plays an essential role on information transmission from the cognitive to the affective level, its detailed analysis draws through this study consistently. According to the result of household assets, the television is the most important media of information access as *Figure 5-11* reveals. The use of newspapers as information media is more common among the user-group. That may be because of the higher educational level and possibly a better economic situation of the household or on certain contacts facilitating the access.



**Figure 5-11 : Users' and Non-Users' Media for Information Access**

Due to these aspects it can be valued as less important for the general diffusion process of innovations. But apart from these information goods, the social groups form a principal way of general information transmission in the Vietnamese society. Particularly in the rural society, where access to modern media is sometimes difficult and where people do not have the possibilities for longer distance travel, the direct and indirect social contacts gain importance. Consequently, it was the objective of the study to get closer information on this issue. *Figure 5-12* demonstrates the results of an assessment on the importance of the different social groups for decision making by the OFHs.



**Figure 5-12 : Assessment of Users' and Non-Users' Attitude concerning the Importance of Social Groups for Decision Making**

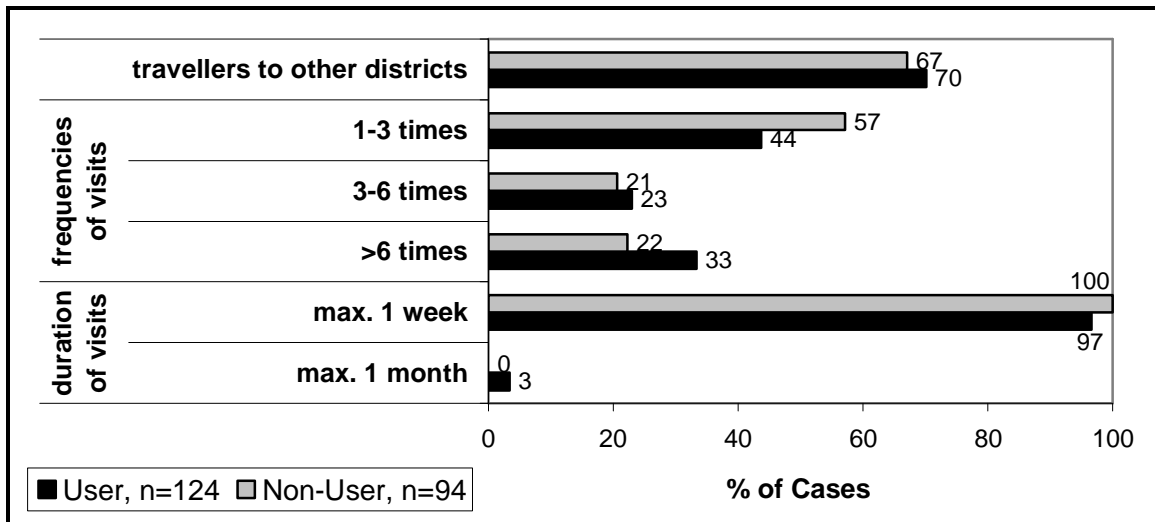
Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Although the question concerned important business decisions, the priority goes clearly from the very private to professional institutional contacts. The direct social environment plays the major role for both User-groups. Nevertheless, the Non-User-OFHs emphasize the relations to mass organizations rather higher. This indicates for project measures that it would be more effective to decentralize the consultants of



information divulgence quickly. Here, an extension service, which is subsidiary and target group based could be an effective approach. Later on, these aspects will be seized again in direct relation to each innovation.

The before mentioned role of traveling for information access and dissemination is a further aspect to be focused on. Especially the temporary travel activity to other districts or even provinces enables receiving new information. During a short stay there might be opportunities to see new products and solutions, to discuss problems from another point of view or even to receive demonstration on those. Specifically the study by ADCOM (2002: 9) mentioned this issue with high importance for sanitation awareness to improve ML-acceptance. *Figure 5-13* depicts the travel activities of both OFH-groups to other districts in frequency and duration. About two-thirds of both OFH-groups get in contact with people of other districts. Taking into account that the majority of OFHs travels more than one time a year which in many cases is founded on the traditions of Chinese New Year (Têt), there must be other reasons, too.



**Figure 5-13 : Users’ and Non-Users’ Contacts to Social Groups in other Districts**

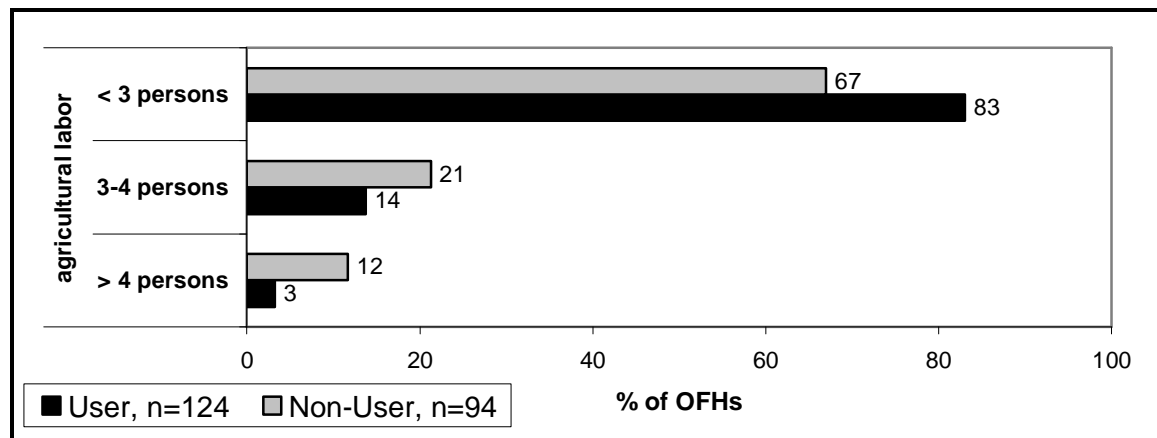
Apart from passing district borders in order to buy and sell products, a current reason is seasonal employment. People most probably travel during crop season of other cultivations than their own ones, or due to contacts to work in non-farm jobs.

In conclusion, the range of social contacts is broad in both cases and also the importance to certain media or groups hardly differs, although the Non-User-OFHs seem to put slightly higher priority on the information of mass organization for decision making in business issues. As mentioned, the access to information plays a key role for acceptance and diffusion and thus, will be evaluated in detail on the innovations’ level. As there is no significant difference in the frequencies and duration of traveling among the OFH-groups, this aspect seems to have no importance for the acceptance behavior.

In the following chapter the subject matter of labor is examined in more detail as it is closely linked to the described travel activities and opportunity to achieve information about some kind of innovation in other localities.

### 5.2.4 Labor

In the operating farm household of the tropics and subtropics, family labor refers to the labor of all family members residing in the same farm. The kind of work can differ between on-farm and off-farm, which describes farming activities on their proper farm and engagement on somebody others farm. Non-farm activities are those that are not related to farming as an employment in some private or public institution, trading, tailor, etc. Regardless the source, each labor contributes its part to the total household income. In Viet Nam persons aged 17 to 60 generally constitute the labor force. But as on a farm also easier work has to be done by younger children as well as the elderly (over 60), they are considered as part of the labor force.

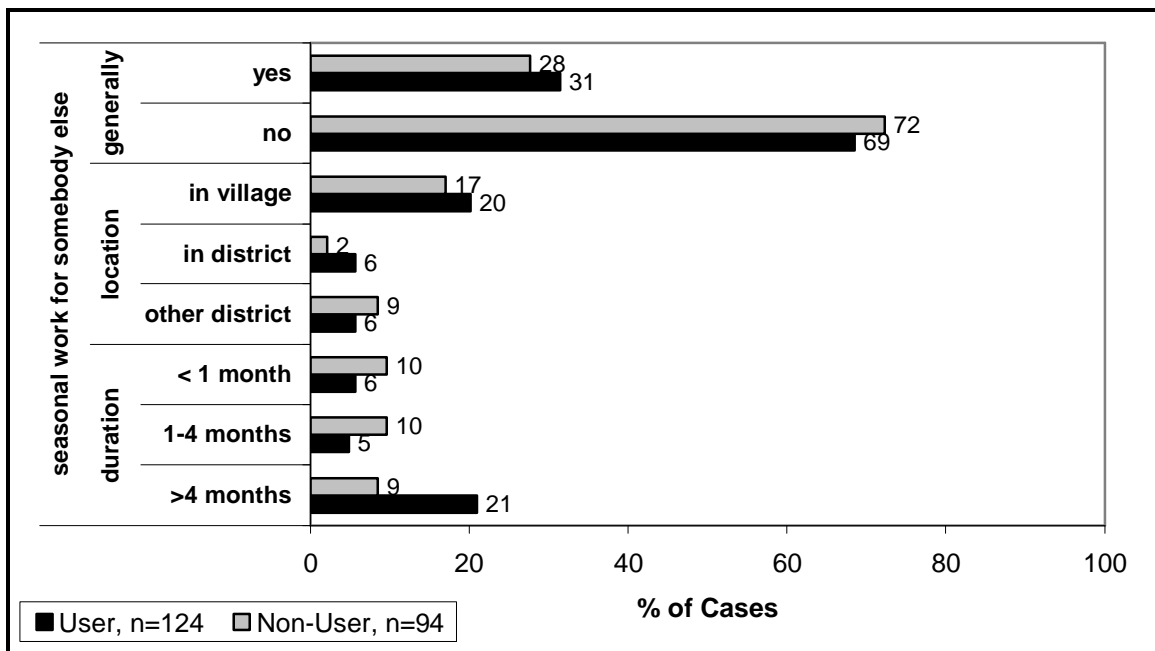


**Figure 5-14 : Number of Users' and Non-Users' Family Members Working in Agricultural Production**

Referring to *Figure 5-5* in which the age structure and average family size is demonstrated, most of the OFHs seem to dispose of only two labor forces. Especially the User-group features a low number of family members (average of 1.9 persons) who dedicate their work to agricultural production. These results may allow the assumption that a significant part of labor forces is dedicated to external activities. The Non-User-group accounts an average of 2.6 persons/OFH working on-farm. Concerning especially the activity of fertilizer application, in both household groups men tend to do this kind of work. Women and children only assist with this task in some cases. This fact implies that for information transmission concerning the aspects of mineral fertilizer substitutes and application, the professional education should principally focus on the men.

The seasonal off- or non-farm work, its location and duration represents on the one hand economic necessity but on the other hand also the possibility to have access to information by new contacts and experiences. The following *Figure 5-15* reveals that about one third of the OFHs dispose of their labor seasonally for someone else.

Worth mentioning is that the majority of those work in the village and a considerable dominance of the User-OFHs works more than 4 months/year for another farm or in a non-farm employment. It can be supposed that these OFHs tend to be of sideline farming character. Overall, during the flooding season poor households have the necessity to look for intermediate employment as they cannot cultivate their land (cp. YAMAZAKI A. DUONG 2000: 33ff). As the employment offer in the same village is limited, they are forced to travel. In the case of User-OFHs, which have a higher living standard a reason to work off- or non-farm, is the repartition on different income sources. Respectively the resulting income risk reduction may be an essential factor for investment and use of innovations.



**Figure 5-15 : Users’ and Non-Users’ External Labor Distribution**

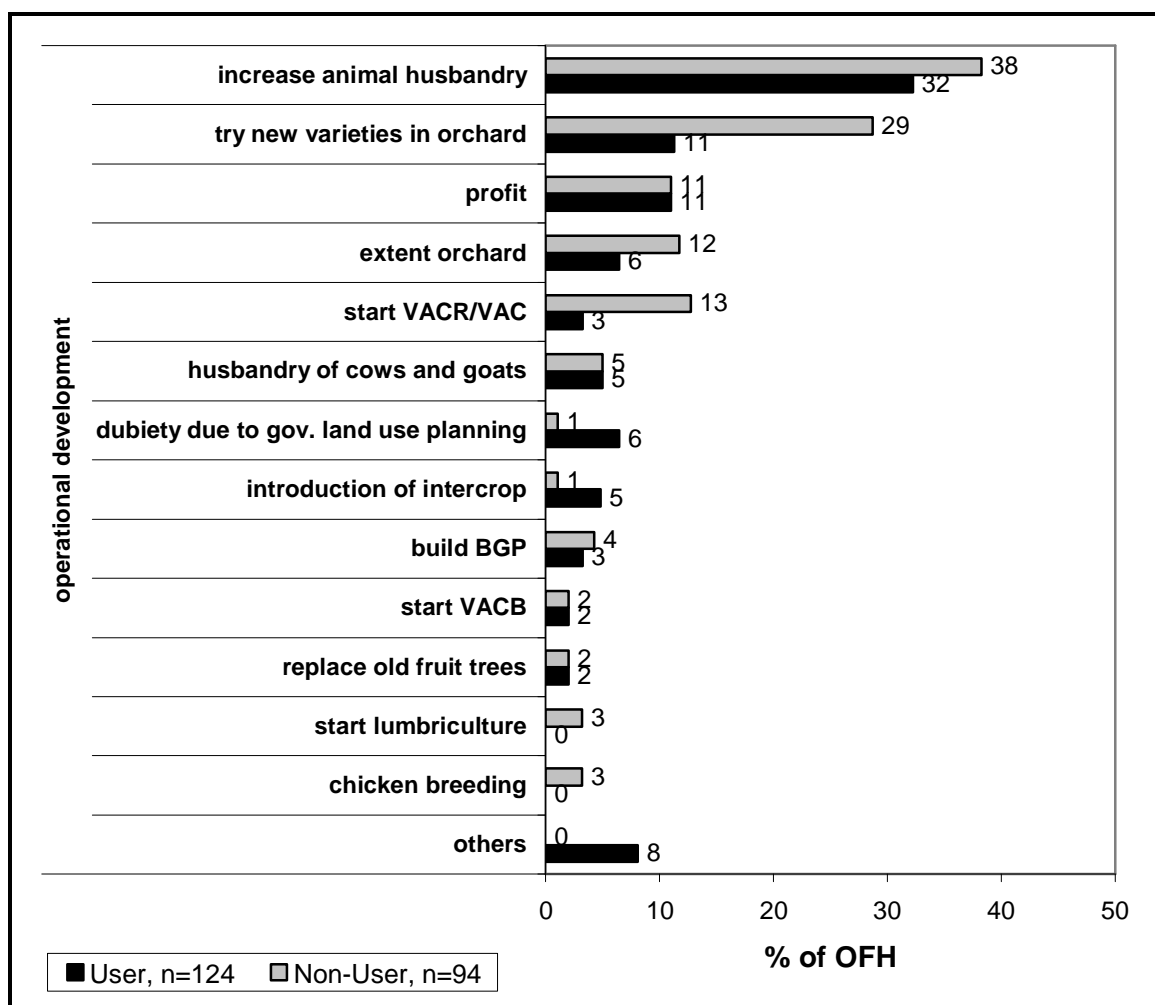
Therefore the economic situation of the User-OFHs will be evaluated in more detailed within the chapter concerning the economic dimension.

In conclusion, User-OFHs have less labor forces dedicated to agricultural production. Referring to seasonal off- or non-farm work, it can be resumed that the majority of cases stay in the village. Seasonal migration in order to seek employment is quite low. The only significant difference in between the OFH-groups is the fact that the User-OFHs mainly work seasonally for a longer period of more than four months. However, the results concerning the seasonal work cannot give explanations on the acceptance behavior.

**5.2.5 Problems and Objectives for Preservation and Development of the Operating Farm Household Substance**

Evaluation of problems and aims on OFH level is a basic requirement for an acceptance analysis. It reveals the constraints and needs with highest priority and gives first impressions on the farmers’ attitude for future activities. The respondents

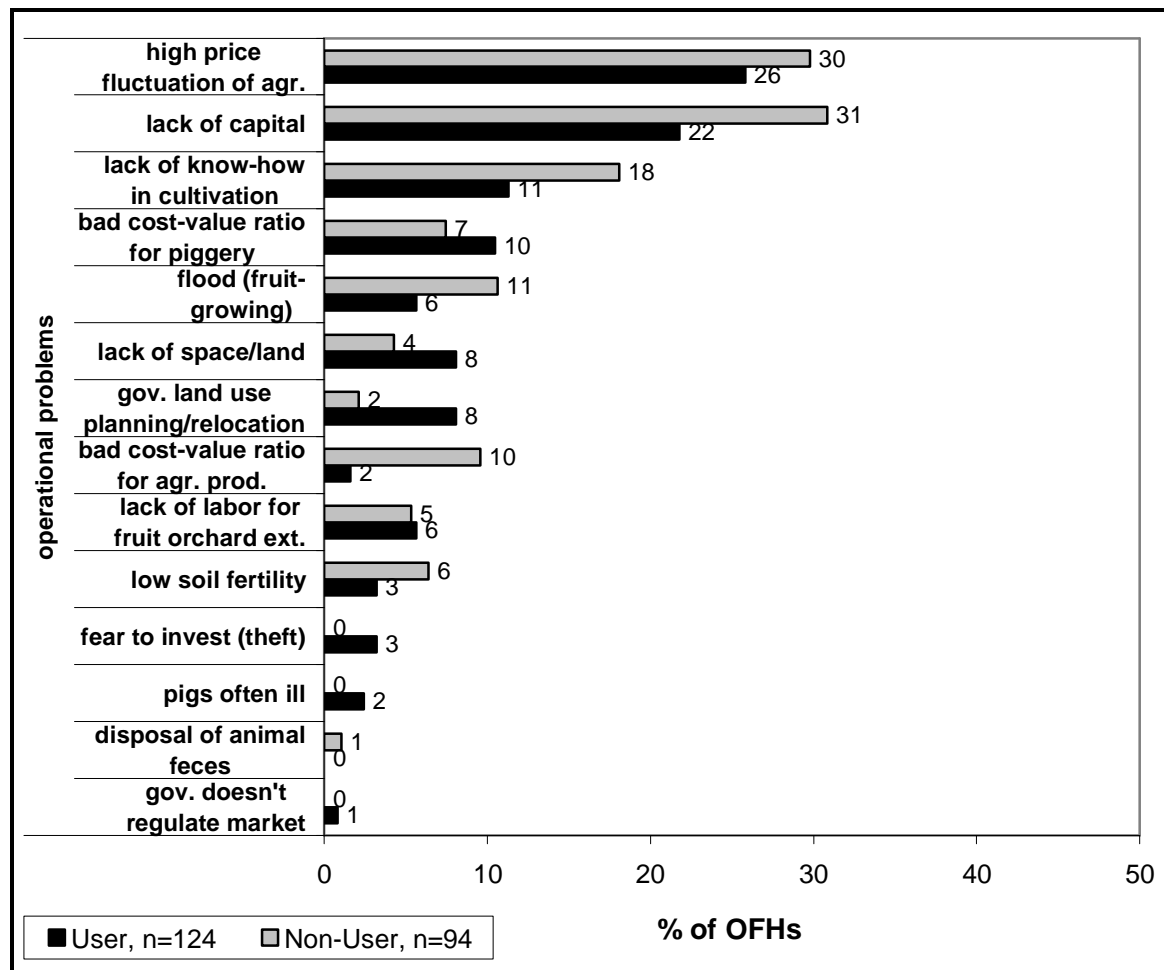
were asked to state their most important objectives for the development of their homestead according to their priority. *Figure 5-16* specifies a number of categorized objectives, the possible three priorities are added up to simplify the visualization. However, first priority of both groups is the increase of animal husbandry. For the user-group (average of 1.0 votings) “profit” was the second most current issue followed by “introduction of new fruit varieties”. In the case of Non-Users (average of 1.2 votings) the same objectives were mentioned, but the latter two rather vice versa. Thus, the priority bases on development of animal and fruit production and in general leading to a diversification of agricultural production in order to reduce income risks and to make profit. Thus, the answers give the impression of a principally economic way of thinking.



**Figure 5-16 : Users' and Non-Users' Personal Objectives for Future Development of OFH** (Multiple choice answers)

The need or wish to invest in BGP is mentioned only by few respondents and ML is not noted at all. Among the rubric “others”, covered only by the user group, mainly non-farm activities (apartment for rent, restaurant, karaoke, etc.) are constituted. The respondents also identified a long list of problems that was processed in the same way as the objectives. In *Figure 5-17* the total of 252 votings are illustrated

according to their summarized priority. The principal three problems are identical for both OFH-groups (Users with average of 1.1 and Non-Users of 1.3 votings) – the lack of capital for further investment, the perceived lack of developing professional knowledge and the problematic market condition. Latter includes both, the fluctuation of agricultural products in general and especially the very difficult cost-value ratio for piggery. The problem of marketing is mentioned in a couple of further statements like general “bad cost-value ratio for agricultural products” and the expressed demand that “the GoV does not regulate the market prices”. These are key-points of interest for the OFH development and possibly essential determinants for acceptance behavior due to the fact that the use of BGP bases on piggery.



**Figure 5-17 : Users’ and Non-Users’ Perceived Problems for Future Development of OFH** (Multiple choice answers)

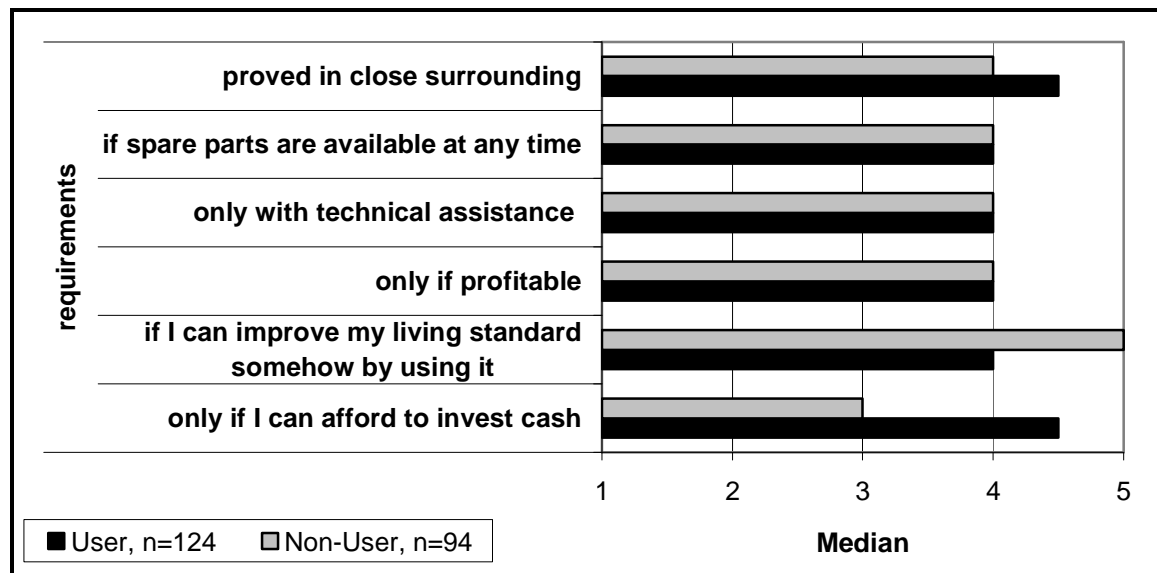
The mentioned lack of capital is a very well known and comprehensible statement of small OFHs in many regions and countries. But of course it is a key point for self-dependent development. This issue is taken up in detail within the paragraphs regarding capital and credit conditions.

However, the OFHs do not value the subject of BGP and ML with high priority, neither in their objective nor problem ranking. As the mentioned points are mainly economic and production related issues, it seems that their relations to the

innovations are hardly recognized in this subject matter. Possible exception is piggery and its marketing as this might be closely linked to the investment and use of BGP.

### 5.2.6 Self-interest and Individualism

Last but not least, a first general check of the respondents' attitudes towards given requirements for acceptance of some undefined new technology for the OFH use was implemented. The estimated basic conditions for acceptance have been strongly affirmed by both OFH-groups. However, *Figure 5-18* shows that two remarkable differences are evident. For the non-user group the improvement of living standard seems to have a stronger value and the user-group noticeable requires investing in cash instead of raising a credit. Contrary, the non-users would prefer to invest with support of a credit if possible. Actually, this is congruent with the results of living standard differences between the OFH-groups.



**Figure 5-18 : Users' and Non-Users' Attitudes concerning Requirements for General Acceptance of New Technologies in the OFH**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Later on, assessments are conducted in direct relation to each innovation. But at this stage the two differences in importance to investment and impact lead to the assumption that OFHs prefer to invest by cash if they have the financial means to do so. And according to this, the impact priority lies on the improvement of living standard as the Non-User OFHs have great necessity to satisfy their basic needs of every-day life.

Hence, this confirms the hypotheses that the innovation's acceptance requires reliability in improving the individual conditions that correspond directly to their self-interest generated by their basic needs.

### **5.2.7 Summary and Conclusions of the Social Dimension**

According to the analysis of social aspects examined, the following statements are kept for reflection in the Chapters of BGP, ML and BGS.

- ↪ Family size adds up to 5.2 persons per household confirming the regional average and in more than 70 % of OFHs the average active agricultural labor accounts 2 persons.
- ↪ Living conditions of Non-User-OFHs are partly worse; 3 % meet food shortage at the end of flood season. But in average they dispose of bigger real estate (1.0 ha for the Non-Users against 0.8 ha for the User-group).
- ↪ Principal educational level is primary school; User-OFHs feature a higher educational level than Non-User-OFHs; level increases from rural to suburban area.
- ↪ Farmstead quality is higher and household equipment is more sophisticated in the case of User-OFHs. In both household groups TV and radio are available to over 80 % and with 90% TV is the principal media for information access.
- ↪ As consultants for the general decision making process dominates the family and close social contacts before members of mass organizations.
- ↪ Mobility rate is high, but mainly short period during the Têt-season; one third of OFHs works seasonally for somebody else (flood season), some change to non-farm employment.

#### **Personal objectives**

- ↪ Personal objectives for OFHs' development concentrate on development of animal and fruit production leading to a diversification of agricultural production in order to reduce income risks. By far less attention is paid to new technologies (e.g. BGP).

#### **Perceived problems**

- ↪ Problems for OFHs' development are the lack of capital, shortcomings in developing professional knowledge and the problematic market conditions. Latter includes both, the fluctuation of agricultural products in general and especially the very difficult cost-value ratio for piggery.
- ↪ Especially in Hoa An flooding and poor soil fertility state a problem for agricultural production.
- ↪ Major requirements for acceptance of new technology seem to be the improvement of living standard, its proof of reliability in close social surrounding and to be affordable in cash (credit unease).

Due to the results in comparison of the User- and Non-User-OFHs it can be concluded that the educational level has influence on the OFHs' development of

attitudes and for acceptance behavior of innovations. Further, the survey shows that in general the User-OFHs have a higher living standard giving them more security to take a risk. They dispose of better household equipment which reflects their higher living standard and in many cases provides more/better communication channels/information access. These are key aspects typical for the group of "Innovators" and "Early Adopters". The social interaction and information access due to travel activity to other villages or districts, and the seasonal work for somebody else differ hardly between the OFH-groups. They cannot give any specific indication concerning the acceptance behavior. Nevertheless, both groups value their direct social environment as very important for decision-making. This should be considered for strategies on introducing innovations in the communities in order to achieve high diffusion rates.

Regarding the preservation of the OFHs' substance, the OFHs make very few statements referring to BGP/VACB. In fact, the assessment on their requirements for acceptance of an unspecific innovation elucidates strong priority for a reliable improvement of their basic needs of every-day life by taking low risk. Hence, no direct relation is perceived between the innovations possible impact and the problems/objectives of the OFHs' development.

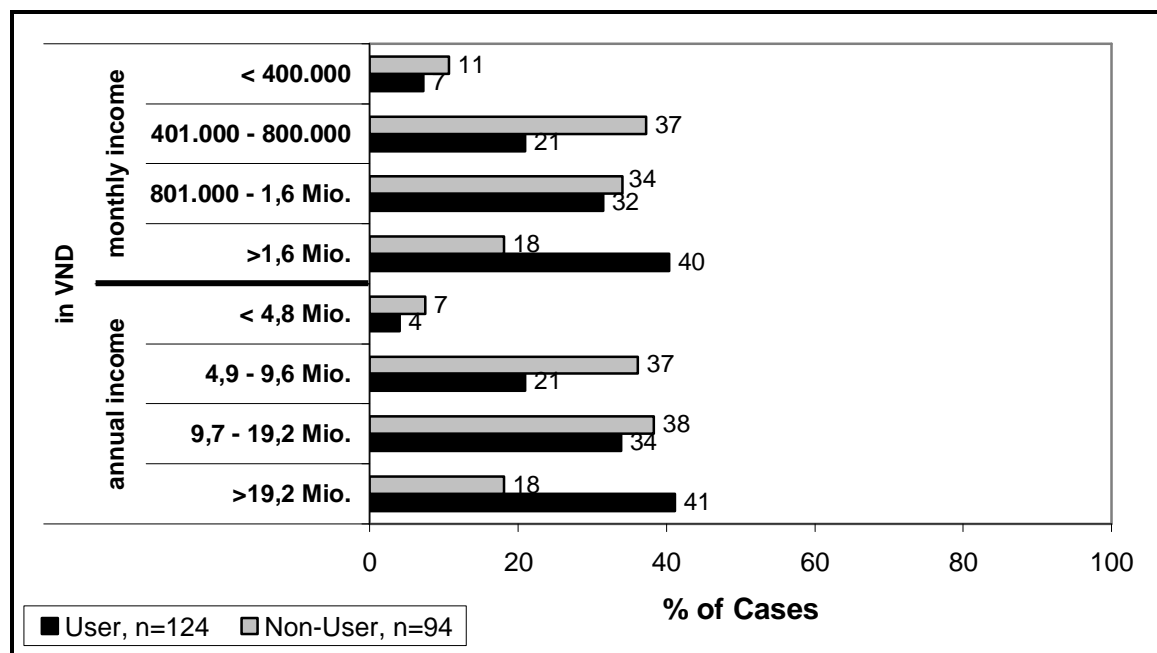


### 5.3 Economical Dimension – Conditions of Basic Requirements for Investment in New Technology

The respondents' expressions of development problems and objectives have revealed that the economic conditions are of high importance for the rural OFHs. The availability of financial resources is needed to satisfy basic needs and decisive for many aspects of life quality, from nutrition to education as well as investment in means of production for further development of agricultural enterprise. Consequently, especially in economically poor households the lack of capital and credit access can be limiting factors for the acceptance of and investment in innovations and even more if they are not profitable. Therefore, in this Chapter the results on cash and livestock capital, liquidity and credit are discussed. Further, agricultural production aspects, especially the use of mineral fertilizer are elucidated.

#### 5.3.1 Capital

First of all the households' income distribution is surveyed as key issue for an overview of the available capital. For the reason that the income can underlie great fluctuations due to the season of year, it was asked for the monthly and annual income estimation per OFH. *Figure 5-19* depicts the according results.



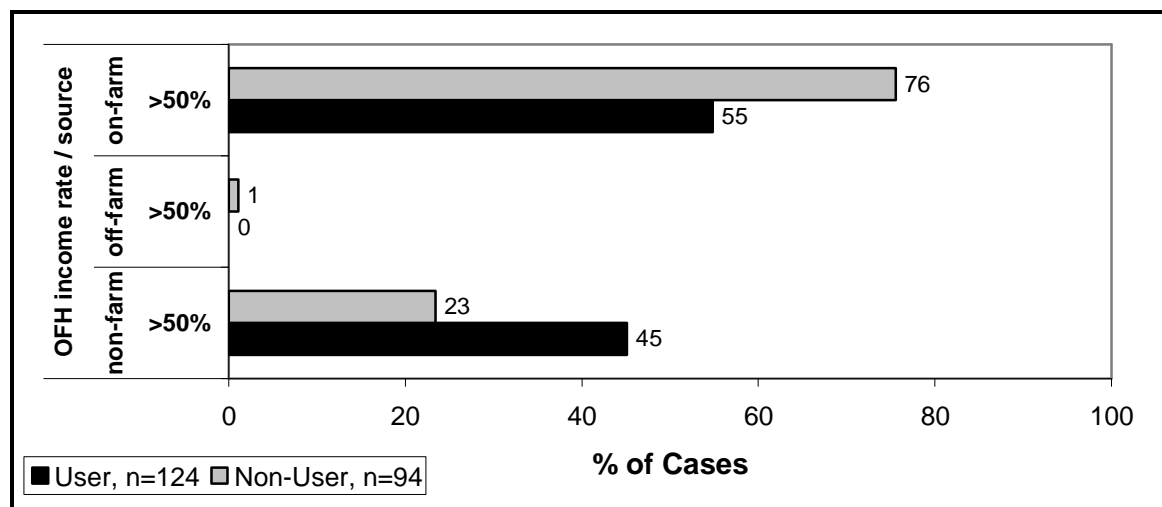
**Figure 5-19 : User- and Non-User-OFHs' Income Distribution**

Comparing the monthly and annual income distribution, no significant gap emerges in none of the two OFH-groups. Furthermore, it is clearly visible that the User-OFHs lead the highest income category<sup>21</sup>. The second highest has almost equal distribution

<sup>21</sup> According to the VLSS the poverty line for rural plain and midland areas was set at 70,000 VND, according the MDP Poverty Assessment at 120,000 VND (UNDP a. AusAID 2003: 22) and due to the recently published "Poverty Reduction Strategy Paper" the poverty line is set at 100,000 VND/person/month (IMF 2003: 12f).

and the lowest two categories are principally represented by the Non-User-OFHs. That means, about 10 % of both User-groups are very poor. In the category of poor with transition to break the poverty line Non-User-OFHs with 37 % almost double the User-OFHs and vice versa respectively the highest income category. This result corresponds to the higher living standards of the User-groups. According to the GSO (2004) rural poverty accounted 30 % of the households on national average and 24 % on average of the Mekong Delta Region in the year 1999. With regard to the results on OFHs' income distribution it can be supposed that in other regions of Viet Nam, the economic situation of OFHs is worse and thus, available capital might be an even stronger constraint for investment and acceptance to use innovations.

The OFHs' sources of income are typically divided into on-farm and off-farm, which means farming activities on their own farm and engagement on somebody others farm. Non-farm activities are those that are not related to farming as an employment in some private or public institution, trading, tailor, etc. *Figure 5-20* reveals that off-farm activities are very scarce. In relation to the frequency of traveling to other villages, districts or even provinces (*cp. Figure 5-13*) the reason seems not to base on lack of seasonal migration. But possibly people migrate to find non-farm employment as the rainy season and flood affects the farming activity in most parts of the Mekong Delta region at the same time.



**Figure 5-20 : Users' and Non-Users' Income Sources**

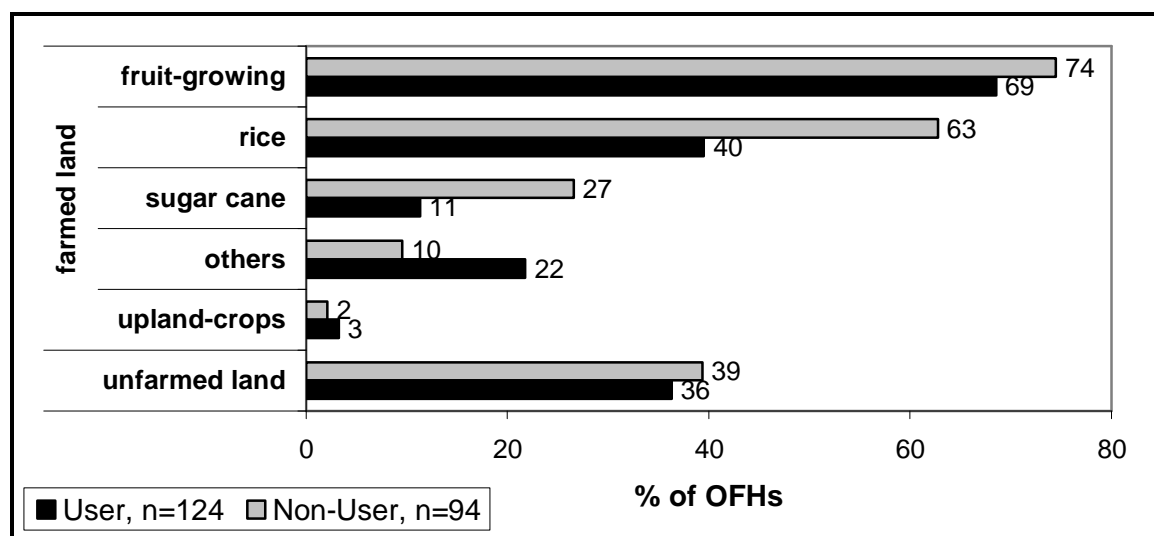
Otherwise remarkable is the Non-Users' outnumbering in on-farm activities and the users' majority in non-farm activities. One reason might be the bigger land tenure of Non-User-OFHs and thus, a broader range of agricultural production and farm labor. As the innovations focus on an improvement of on-farm activities this might be conducive for their acceptance. By comparison, the User-OFHs on an average have less land tenure and require another income source which seems to be non-farm. Hence, the OFHs with farming activity but dominance on non-farm activities have probably a more continuous income. This is an important risk reducing precondition for investment in cash and even more for borrowing.

Further, this fact fits into a core element for acceptance of BGP. The principal BGP introduction was based on piggery. But the market prices for fodder as for pig underlie a very unfavorable fluctuation and may present a killing factor for acceptance and sustainable use of BGP. In the according chapters this issues will be evaluated in detail.

### 5.3.2 Agricultural Production

Within this chapter two principal aspects are going to be evaluated. First, the objective is a detailed description of agricultural production composed by the main topics of plant and animal production including land use as well as information about the use of mineral fertilizer. Secondly, agricultural production, especially the livestock is not only part of the income but also needed as collateral for raising credit. All issues are always presented and analyzed by comparison of User-OFHs and Non-User-OFHs.

Figure 5-21 reveals the distribution of farmed land according to cultivation and it is visible that the dedication to fruit growing is rather equal for User- and Non-User-OFHs. The latter group clearly dominates in cultivation of paddy rice and sugar cane (Hoa An is prevailing in sugar cane cultivation and Non-User-OFHs in the sample). This may be reasoned by their average bigger land tenure.

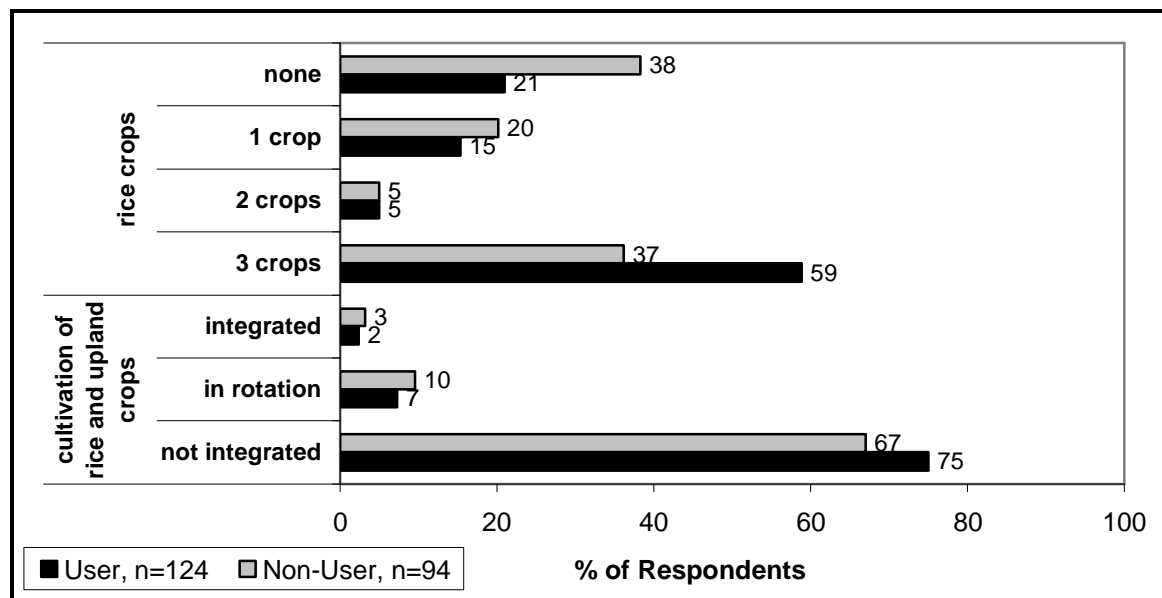


**Figure 5-21 : Users' and Non-Users' Land Use** (Multiple choice answers)

In addition this kind of land in most cases is flood prone, located in some distance to the dwelling and is difficult to sell as building land. Contrarily in Long Tuyen and An Binh many OFHs tend to sell part of their land as here the value has risen very much due to the vicinity to Can Tho City and its development plans (since end of 2003 municipality status). These OFHs use this one-time capital injection to invest in the fruit orchard or other production units but overall in the construction of a new house. Considering the OFHs' average farmed land size of the principal cultivations, it is rather similar as fruit growing tends to be at almost 0.5 ha, paddy rice and sugar

cane cultivation reach an average land size of 0.7 ha in both OFH-groups. Contrary, upland-crops are cultivated on an average of 0.03 ha by the Non-User-OFHs and on 0.2 ha by the User-OFHs.

Regarding the common cultivation forms, fruit-growing is generally a long-term cultivation depending however on the type of fruit.<sup>22</sup> Sugar cane is produced as perennial plant with remaining cultivation for several crops. Paddy rice is the principal issue as most of the farmed land is used for rice production in the Mekong Delta. As illustrated in *Figure 5-22* it can be distinguished between the amounts of crops per year. The promoted (CTU, Framer's Union) tendency to increase production is three crops per year. That is the reason for almost 60 % of the User-OFHs following this practice. The cases of integrated cultivation or rotation of cultivations is low. Upland-crops are principally cultivated on dikes around the paddy or on small patches between water channels. Usually it is pumpkin, cucumber or corn and due to the climate only produced in the rainy season from April to October.

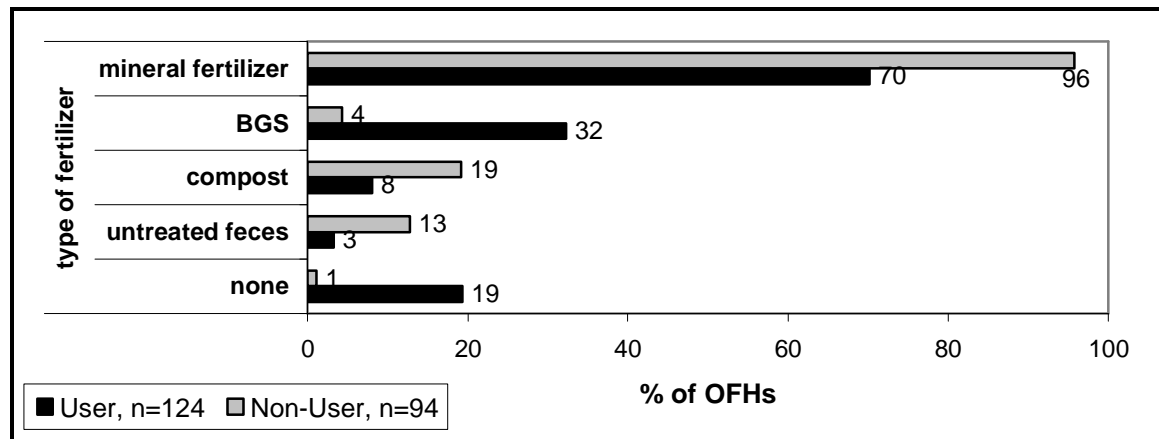


**Figure 5-22 : Users' and Non-Users' Plant Cultivation Forms**

In the scope of plant production fertilizer use is an important production factor the OFHs principally have to pay for. Contrary, land and labor they are able to dispose by their own. Furthermore, the first overview of fertilizer use shown in *Figure 5-23* is important for the later evaluation of organic fertilizer especially BGS use (*cp. Figure 5-74*). Almost every Non-User-OFH and three quarters of User-OFHs use mineral fertilizer. BGS is used by one third of the User-OFHs and also a couple of Non-User-OFHs seem to acquire BGS. This indicates at least that BGS is used by OFHs producing and not producing it by their own. These issues are analyzed in detail in the chapter related to organic material and BGS. In the use of compost and untreated feces, the Non-User-OFHs outnumber the User-OFHs, although this practice is not

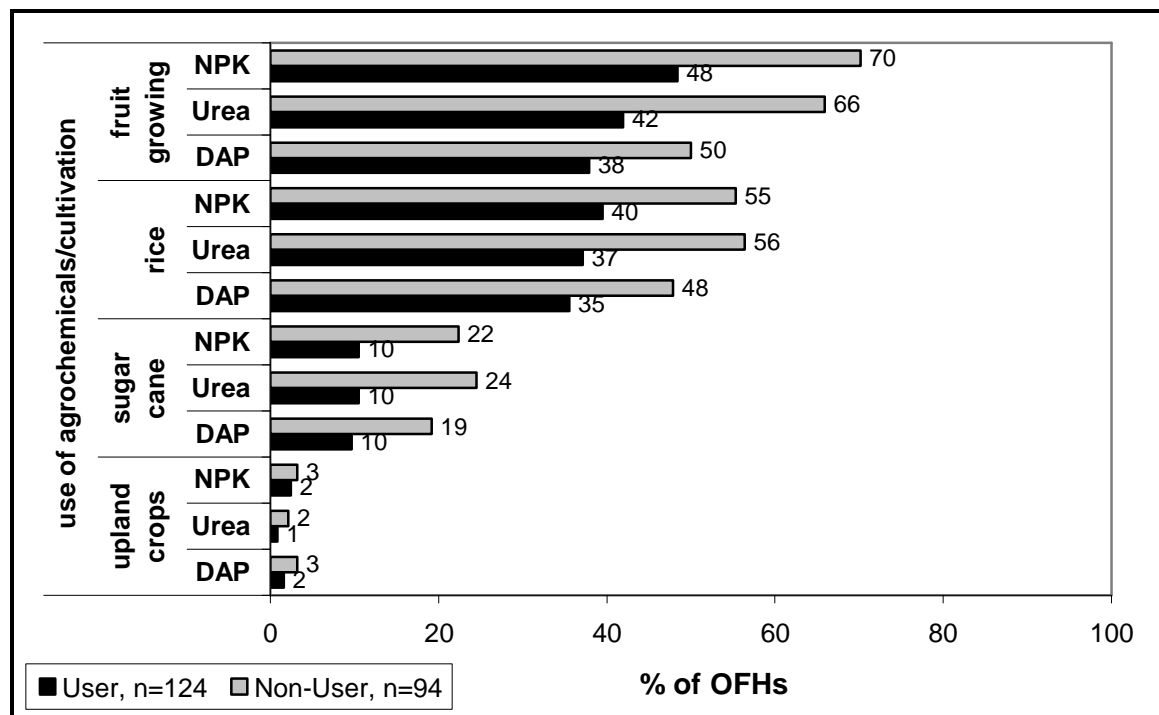
<sup>22</sup> Most common fruits are zapotilla, tangerine, lemon, hog plum, longan, papaya and banana.

very common. Further, almost 20 % of the User-OFHs do not use any fertilizer at all. These OFHs possibly do not dedicate their labor to plant production but on animal husbandry and an additional non-farm income.



**Figure 5-23 : Users’ and Non-Users’ Use of Fertilizer**

As the issue of agrochemicals’ use is an important aspect from economical point of view as well as for environmental and health conditions, *Figure 5-24* illustrates its use according to type and cultivation.



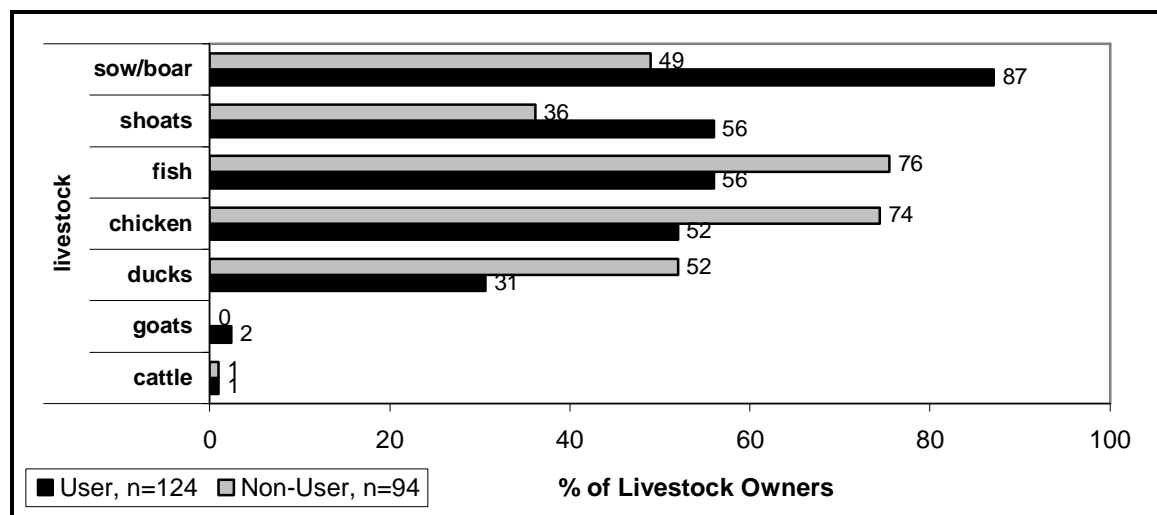
**Figure 5-24 : Users’ and Non-Users’ Use of Agrochemicals According Cultivation**

Multiple choice answers. **DAP** = (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>; **NPK** = 16 % N + 16 % P<sub>2</sub>O<sub>5</sub> + 8 % K<sub>2</sub>O + 13 % S; **Urea** = CO(NH<sub>2</sub>)<sub>2</sub>

Obviously more Non-User-OFHs are using mineral fertilizer in all types of cultivation. As illustrated in *Figure 5-21* the Non-User-OFHs dispose of more farmed land in the principal three cultivations and further it depends much on the soil quality, species and age of fruit trees as well as other factors more. But it can also be assumed that

this fact might be based on less professional education as well as the use of BGS as organic fertilizer by the User-OFHs. However, for an economic estimation it can be calculated that the amounts of applied mineral fertilizers account of 0.5 to 1.2 t/ha per year. Taking an average price of 3,200 VND/kg into account, that means 1.6 to 3.8 million VND per year only for mineral fertilizer application<sup>23</sup>. Consequently, the investment in mineral fertilizer is about 10 to 30 % of the annual income as most OFHs dispose of approximately 9 million VND (cp. *Figure 5-19*). The flower stimulating DAP is especially used for citrus to calculate the crop just before Chinese New Year (Têt) as in this period prices for all goods with yellow, orange and red color are very high due to its symbolic value of fortune and wealth in the buddhistic belief. The average mentioned amount of DAP accounts 0.3 t/ha per year which, with an average price of 4,000 VND/kg, amounts 1.2 million VND. This rough calculation makes it clear that even a partially substitution of mineral fertilizer by organic fertilizer (BGS) principally produced by excrements is of economical interest. But of course this depends on the viability to put into practice. On the one hand the knowledge about the substitution potential due to its nutritional contents as well as the according information transmission on this advantage.

Livestock is the second aspect to be analyzed in this paragraph. Referring to this, *Figure 5-25* depicts the preponderance of piggery by the User-OFHs. Almost 90 % of them own adult pigs.

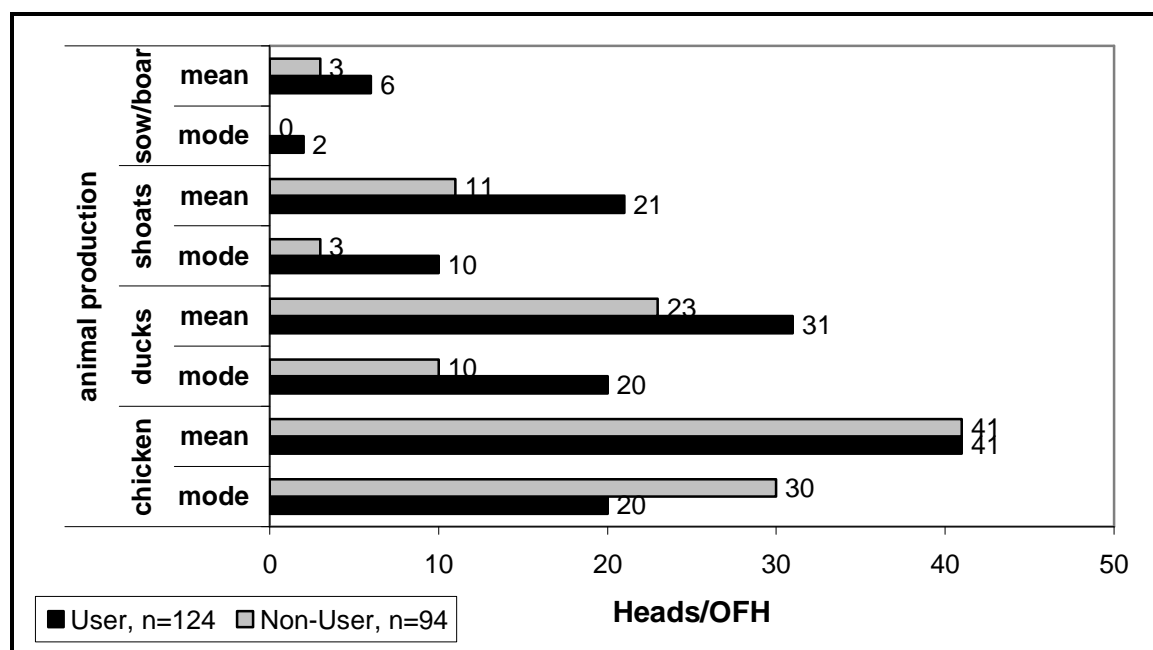


**Figure 5-25 : Livestock Owner in Comparison of Users and Non-Users**

Together with some OFHs which have only a couple of shoats it adds up to 92 % of User-OFHs rising pigs. Nevertheless, at least half of the Non-User-OFHs have piggery as well. Furthermore, these OFHs outnumber the User-OFHs in producing fish and poultry. Subsequently to the distribution of the OFHs husbandry dedication, *Figure 5-26* reveals the average amounts of heads in mean and mode. The User-

<sup>23</sup> Average prices and amounts base on the information of several in-depth interviews with household heads of the three research sites in the scope of the pilot study in April 2003.

OFHs have on average more pigs and ducks, in case of chicken it is vice versa. Further, the User-OFHs own in most cases two adult pigs and 10 shoats, the mean is even higher. These numbers confirm another typical character of poor and wealth-off households. The latter usually own the more valuable animals, poorer families can only afford to raise poultry as a first step of livestock capital. The few cattle and goats also belong to the wealthier OFHs and these mentioned as well the intention to invest in cattle and goats for the development of their OFHs (*cp. Figure 5-16*).



**Figure 5-26 : Users' and Non-Users' Animal Production**

Among the sample, one half of the Non-User-OFHs own adult pigs and/or a couple of shoats. Hence, more than three quarters of the whole sample has piggery. With regard to the 53 % total growth of pig livestock in Can Tho Province during the period from 1995 to 2003 a progressive tendency leading to more OFHs with piggery and thus, higher demand for BGPs can be assumed (*cp. Table 2.2*). Even if the number of heads or age would not be enough to satisfy the required input for BGP, they dispose of the operational base. Together with the connection of a ML or in share with the neighbor or other constellations, they would have the opportunity of a profitable installation. Thus, the principal branches of agricultural production would be influenced positively by the use of the surveyed innovations. Concerning aquaculture Non-User-OFHs produce five times more sticklebacks and about one-third more fish, mostly gourami<sup>24</sup> species (5,000 VND/kg). But the User-OFHs dispose of three times the amount of the higher valued catfish production (10,000 VND/kg). As later examples will show, also the aquaculture can be benefited by the installation of BGP and connected ML.

<sup>24</sup> All gourami species can breathe air using a special 'labyrinth organ' which acts like a lung, enabling them to survive in oxygen-depleted waters.

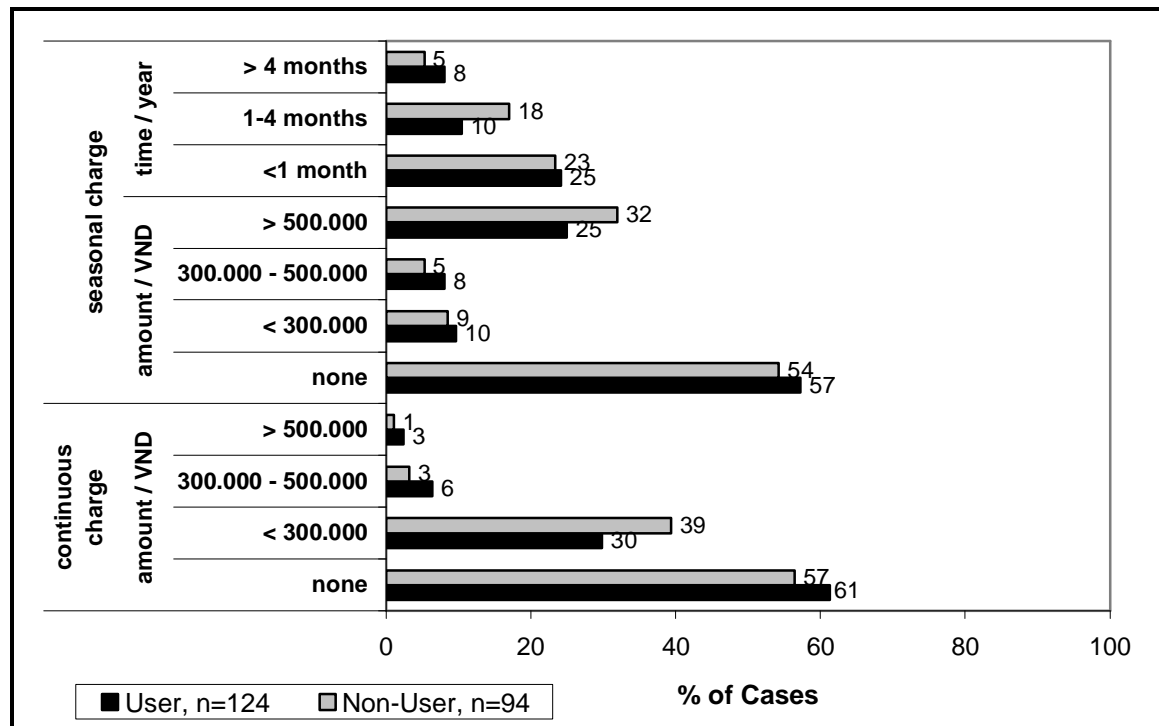
In conclusion, User-OFHs have preference on animal production and herein especially the higher valued piggery. Almost 90 % of the User-OFHs have piggery which is congruent to the fact that BGP is distributed on this characteristic. Regarding the aquaculture they prefer the higher valued catfish instead of gourami species. Due to less land tenure as well as less farmed land the plant production of the User-OFHs is lower except upland-crops which may base on BGS use. The Non-User OFHs situation is therefore vice versa. Furthermore, they have higher expenses due to the high amounts of agrochemicals for the production of rice, sugar cane and fruit. They may be more dependent on credit rising and may have a higher financial threshold due to less available collateral.

These results lead to the assumption that the User-OFHs dispose of higher non-cash capital. As expected, the amount of used agrochemicals is very high and consequently polluting the environment, especially the water sources (UNDP A. AUSAID 2003: 5). Motives for acceptance of the focused innovations can be divided into two main aspects. The first is the economic advantage in the case that BGS would be able in quantity and quality to substitute at least partially mineral fertilizer and thus, reduce production costs. Further, the effluent can be used directly for the aquaculture which means that there is not necessarily a loss even in the case of replacing the fishpond-latrine by a ML. Secondly, the improvement of life quality in the sense of better hygienic and ecological conditions might be a pushing factor if the OFHs conscious of this issue is high enough.

### **5.3.3 Liquidity**

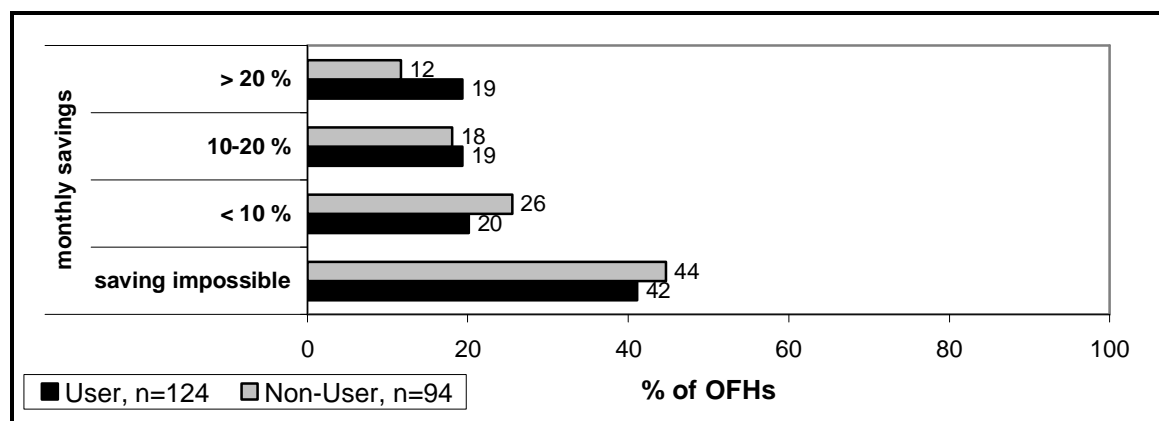
Apart from the income structure and livestock capital, it is essential to have a closer look on seasonal and continuous financial charges as well as the possibility of savings in order to enable approximations about the OFHs' liquidity. Seasonal charges of agricultural production are mainly payments due to hired machines or labor. Taking the seasonal charges into account, *Figure 5-27* illustrates that less than half of the OFHs have some kind of charges. More than 50 % of the OFHs, which have seasonal charges, are burdened for one month or less. In the category of the amount over 500,000 VND dominate Non-User-OFHs. It can be supposed that the majority of these cases rely on necessities during the planting and/or crop season. Continuous charges are credits to be paid back in continuous form of a longer period. Thus, in most cases the amount does not pass 300,000 VND. However, the Non-User-OFHs slightly prevail in the burden of seasonal and continuous charges and analyzing the OFHs which have both kinds, the Non-User-OFHs gain with 22 % instead of 15 % of the User-OFHs.





**Figure 5-27 : Users’ and Non-Users’ Financial Charges**

Finally, the opportunity to make savings is evaluated to come to a conclusion regarding the liquidity of the OFHs (Figure 5-28). For over 40 % it is impossible to make monthly savings. According to the results before, the User-OFHs are more able to make savings of their monthly income in the two upper categories (> 10 %). These are no great differences but they support the other results characterizing the User-OFHs to be economically better off.



**Figure 5-28 : Users’ and Non-Users’ Saving Rates**

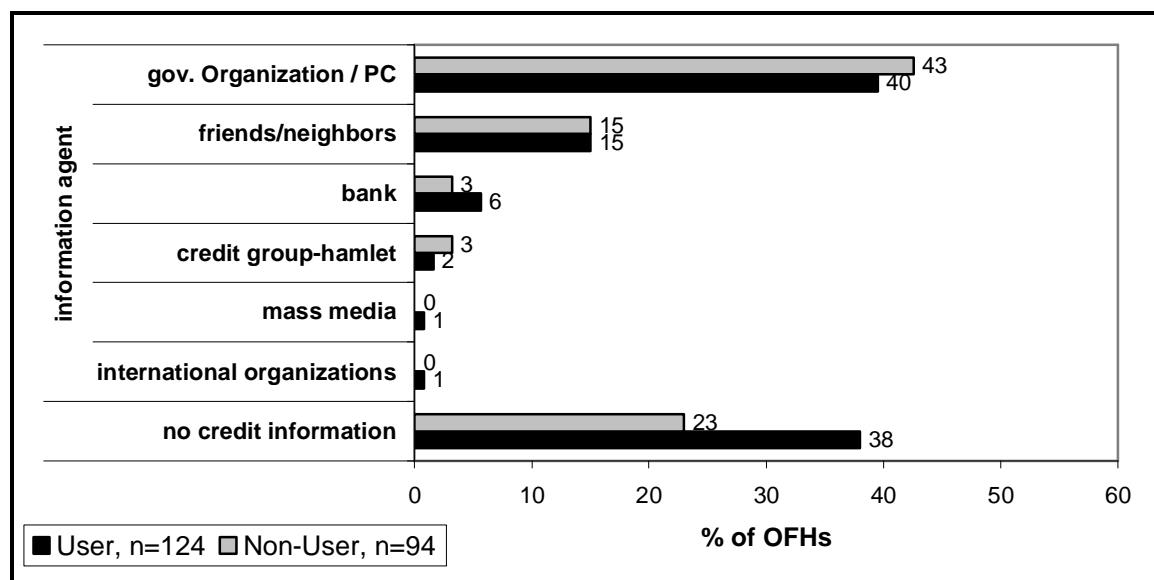
At this stage it can be said that referring to cash availability and possible livestock collateral the economical conditions of the User-OFHs are rather better off than those of the Non-User-OFHs. They dispose of the higher income, more valuable livestock, require less labor in agriculture due to less land use for plant production, have less expenses for fertilizer and dispose of probably less chancy but increased non-farm income. It is to analyze if this distribution continues in the aspect of credit conditions.

### 5.3.4 Credits

Due to the difficult economic situation of the OFHs, in many cases credits are needed to overcome periods of income drop out and are the principal way to invest in the development of enterprise. In the scope of Doi Moi movement the credit market improved significantly. With the VBARD, SPB<sup>25</sup> and cooperation of mass organizations an institutional network was set up and due to the outreaching liberalization of the financial market, interest rates were also liberalized completely. Accordingly, WÖRZ and ENGEL (1998: 61ff) reported that in 1995 almost three quarters of credits were allocated by private persons or moneylenders and the remaining by banks and credit cooperatives with interest rates of up to 3 % per month. Nowadays, the distribution of credit allocating institutions/persons is vice versa and the interest rates generally are around 1 % per month (MAERTENS 2004: 10f). The recent research affords by ZELLER and MEYER (2002: 3ff, 361ff) led to the concept of the “critical triangle of microfinance” which concerns the three issues of outreach (reaching poor households in quantity and quality), impact (on the credit recipients’ quality of life) and financial sustainability (long-term cost covering).

An objective of this study is to describe the actual conditions of credit allocation in the research sites and to analyze the respondents’ perceptions and experience with this issue referring especially to BGP and ML.

First of all it is essential to get information about credit allocation. Consequently, *Figure 5-29* demonstrates the results of the information agent assessment.

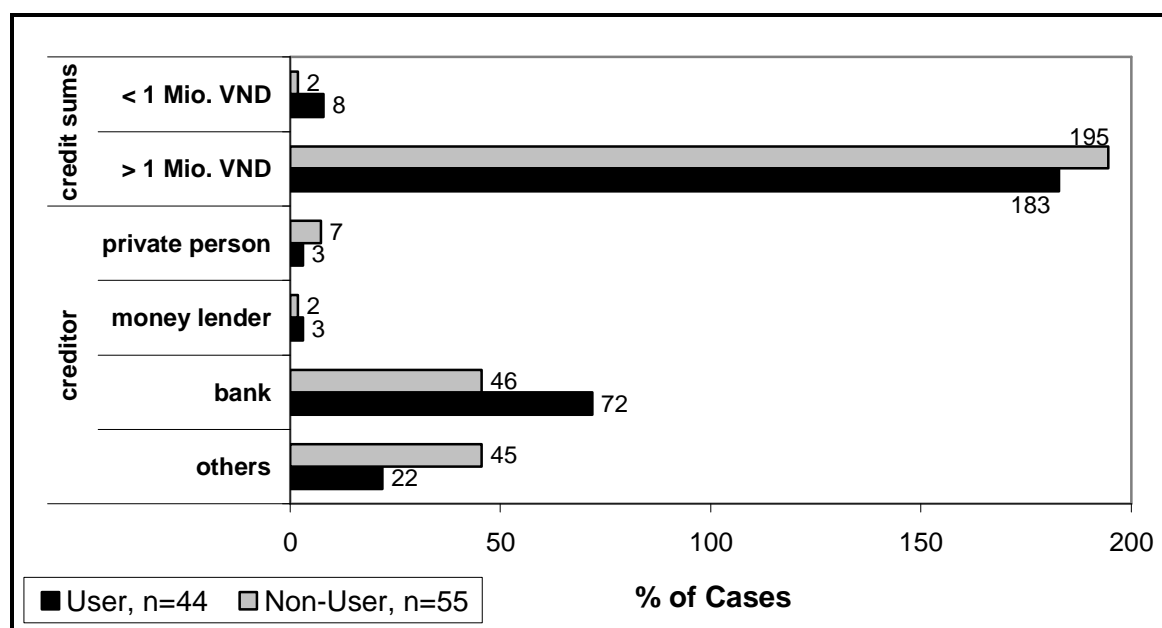


**Figure 5-29 : Users’ and Non-Users’ Information Agent for Credit Allocation** (Multiple choice answers)

<sup>25</sup> **VBARD** is the former Agricultural Development Bank that changed to the Viet Nam Bank for Agriculture and Rural Development and provides credit directly to rural households. Since 2003 the Social Policy Bank (**SPB**) evolved as a sub-section of VBARD especially for the poor households, lending at a subsidized rate of about 0.5 %.

It is clearly visible that the governmental organizations, especially the PC, are the contact institution for the population and which spreads the information. Nevertheless, information transmission by the direct social environment of friends and neighbors plays the second most important role. Bank and credit-group have lower importance in this aspect.

After clarifying the communication channel for borrowing, it is necessary to know about the amount and frequency of credit rising as about the contacted creditors. More than half of both User-groups use credits (User 52 % and Non-User 59 %) and thus, have experience in the procedure. *Figure 5-30* demonstrates that the great majority of raised credits accounts over 1 million VND and the average is about two risen credits per OFH.



**Figure 5-30 : Users' and Non-Users' Raising of Credit**

That means those who are able to get a credit, make use of their chance. Even though the amount of 1 million VND referring to the OFHs' income can be considered as a consumptive expenditure (no need for credit), the decision on the set of categories was made because of the BGP and ML average investment costs of about 500,000 VND each. In this context, one should be aware of the necessity to consider the income distribution over the year (probably high variation due to crop seasons) and not only the average income per month. Further, a hypothetical calculation on PE-BGP refinance time (*cp. Chapter 5.8.2.2*) shows that 1 year would be sufficient, assuming that the OFHs depend on the use of liquefied petroleum gas (LPG). Only very few credits have smaller values, which normally are taken in an informal way as there is no offer to take a formal credit with small amount on a longer period of time. But the lending of small amounts by private money lenders seems not to be very common, although the OFHs express their demand (*cp. Figure 5-31*). The analysis concerning the creditor shows the correspondingly lower activity of informal

channels. Furthermore, the results indicate a significant difference between the User-OFHs and Non-User-OFHs. The latter receive less credit at the bank but dominate among “others”. The category “others” is composed by different projects of international organizations and the University (CTU), which offer funds in different types of credit systems (e.g. Joint Liability Group in the Women’s Union). These creditors have better conditions and prefer to support households that have problems in raising credits. Contrary, the User-OFHs dominate in using the bank as creditor probably due to their favorable economic conditions for credit rising and a certain amount sums up among “others” as they participated in projects offering credits for investment in one of the surveyed innovations.

Therefore it can be concluded that the knowledge about credit access and also the willingness to use as well as the made experience are relatively high. Now, the question on credit conditions, its perception by the OFHs as well as opinions due to the OFHs’ experiences and possible reasons against credit rising comes up.

In additional key-person interviews<sup>26</sup> more detailed information about credit allocation systems and conditions could be achieved in the three research sites. Principally, it is distinguished between credits for persons with and without land certificates in the function of main collateral. Within the credit allocations it is distinguished between the loan purpose of production and construction in the three communities.

#### **Credit allocation with land certificate as collateral: VBARD/SPB**

- ↪ 0.9-0.95 %/month for 9-12 months of duration. Interest has to be paid back quarterly, the credit sum in one instalment at the end of contract. (for agricultural production means, e.g. fertilizer, seeds); 2-200 Mio. VND
- ↪ 1.05 %/month for up to 3 years of duration. Interest has to be paid back quarterly, credit sum in one instalment at the end of contract. (for construction, e.g. house, latrine, BGP); 2-200 Mio. VND
- ↪ Amount of credit depends on value of collateral as commonly land according to size, location and use and/or livestock (e.g., property of 1 ha + 5 pigs = 5-10 million VND possible credit sum).

#### **Credit allocation without land certificate as collateral: Mass organizations (Farmer’s Union, Women’s Union)**

- ↪ 0.7-1 % per month and 200.000 - 2 million VND. Interest has to be paid back monthly.

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26 Expert-Interviews: People’s Committee of the three Villages 22-23/12/2003 realized by the author together with translator.

↪ Duration of 6 months as Joint Liability Group or Rotating Credit (Hui-, Phuong-System<sup>27</sup>) in the Women's Union and 3-4 months (Farmer's Union). Here it depends on the crop season as the credit will be discounted directly when they sell their products.

Further, other properties, overall livestock, are valued as collateral for credit allocation. Last but not least the person's character based on his business history, privilege and image as well as his social behavior concerning community activities, are considered for the final decision. This indicates that the screening of an OFHs' creditworthiness is not standardized and hence, varies between the creditors and communes. In the systems of group lending that gained ground since it was introduced by the Grameen Bank in Bangladesh in the late 70s, the direct social interaction with the members' image value plays the principle role to assure liability. However, in none of the villages a special credit programme exists to facilitate the investment in BGP or ML. Only technical assistance for PE-BGP is provided by the extension service if required. The sporadic projects of small NGOs concerning water and sanitation issues cannot absorb the deficiency of an established network and offer of appropriate credit programs.

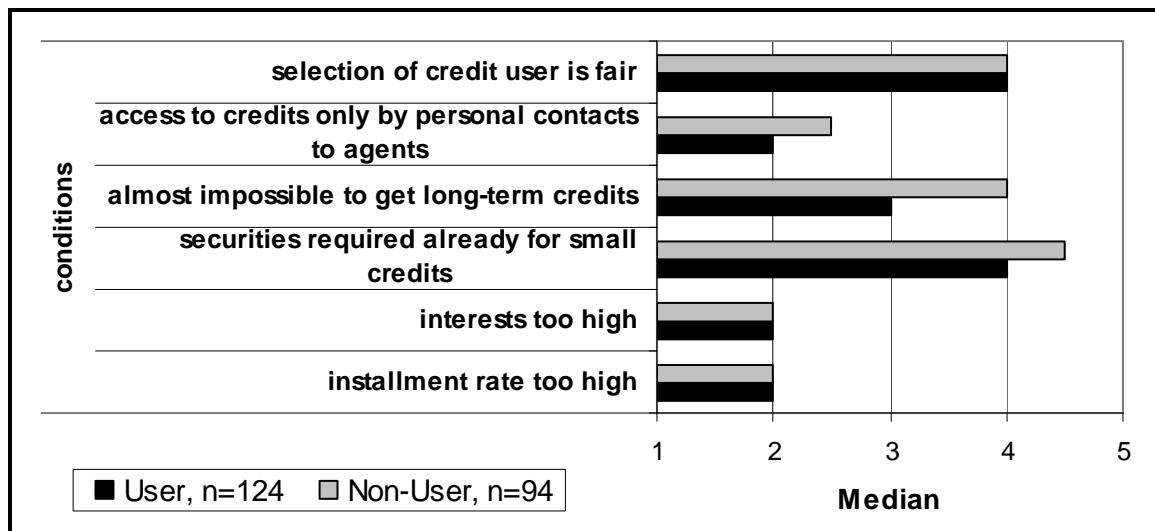
In regard to this information, two further assessments are made to conclude the picture of aspects related to credits in general. The interviewed respondents of both User-groups valued their experiences of access to credits and payback conditions as moderate with trend to good. *Figure 5-31* illustrates the results on perceived conditions of credit allocation by the OFHs which have raised at least one credit. The assessment proofs the information of the PC and leaves a positive impression except two evaluated aspects.

Although the respondents state that the credit access is good, they confirm the requirement of collaterals even for small credits and the problematic access to long-term credits, probably a hint to difficulties in poverty outreach. Even the User-OFHs which dispose of better economic conditions confirm that it is almost impossible to get a long-term credit for small amounts. In terms of the interest and installment rates seem to be no significant constraints. This indicates, as in other studies, that the critical triangle of micro-finance is not necessarily improved by "cheap" credits. Far from it, several case studies have revealed that low rates may have the very negative effect to fall into debt trap (MAERTENS 2004: 35ff).

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27 Rotating credit systems and saving associations organized by local mass organizations, in most cases by the Women's Union or Farmer's Union. **1. Hui-System:** Members deposit savings that constitute a fund for lending to each group member in turn. They receive up to 1 % interest on savings and can borrow at an interest rate of 1 to 1.5 %.

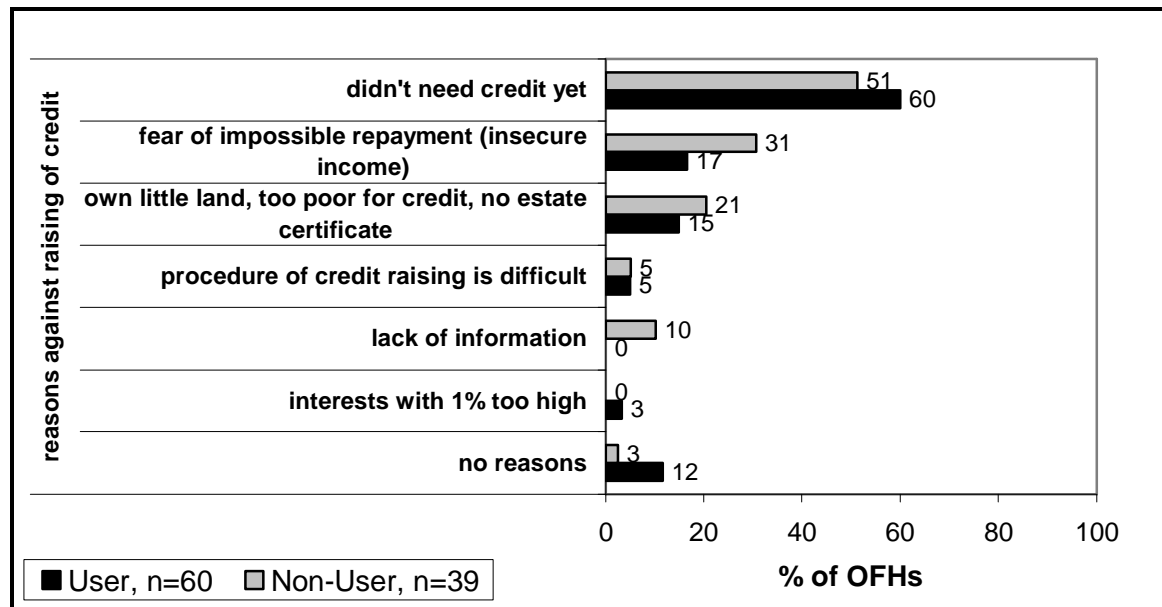
**2. Phuong-System:** No interest on savings or on loans and every member has the right to borrow the whole fund once in every cycle.



**Figure 5-31 : Users' and Non-Users' Assessment of Credit Conditions**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Last but not least the OFHs which up to now did never raise a credit were asked for the most important reasons to do so. *Figure 5-32* illustrates that the majority did not need to raise credits, overall of the User-OFHs. But this may signify that they did not want to invest in something, they would need a credit for as well as they possibly have enough capital to undertake the wished investment. Further it has to be kept in mind that the fear of indebtedness is vital. Due to the conditions of credit allocation they need to have a steady, reliable income or an investment with low risk to fail in making profit. In relation to their average income and corresponding saving rates the payback time is quite short. Furthermore, in many household the income can be assumed to be irregular with a bias from non/off-farm to on-farm activity. During the interviews a couple of respondents explained that they had invested in piggery one to several times becoming indebted due to the low market prices at the time of selling. They had to sell part of their land or even the house to get out of the vicious circle. Furthermore, the results show that there is a considerable number of OFHs which do not have access to credits due to their conditions and that appropriate information and consultancy is missing. Thus, it seems that part of the "Pioneers" (according to ROGERS) made bad experience and for the "Early Adopters and Majority" the risk is still too high due to lack of information and an unsteady income.



**Figure 5-32 : Users' and Non-Users' Assessment of Reasons against Raising of Credits**

Multiple choice answers.

According to the results of credit conditions this could be improved by the opportunity to take a small credit with a longer payback time of smaller installments. The problematic credit access due to no estate certificate or small or even no land tenure reveals administrative constraints as well as the existence of difficulties concerning the poverty outreach.

In conclusion, the network for microfinance and its conditions has improved in the last years. The knowledge and access seems to be good for the majority of OFHs. Nevertheless, the credit allocation requires a standardized screening of the OFHs' creditworthiness. Furthermore, the communication should be improved and it is necessary to think about specified credit and saving programs to support the principal development objectives. It should be kept in mind that the financial institution is economically sustainable as long as its social benefits outweigh its social costs (ZELLER A MEYER 2002a: 7f). Thus, the institutional network which means especially the Women's and Farmer's Union as well as the Extension Service possibly require support in their organizational structure, capacity building and financial budget to offer appropriate credit allocation or to build-up saving groups for the investment in BGP and ML. This may facilitate to achieve the enhancement of sanitary and hygienic conditions as aimed by the NRWSS. Due to the market situation, it is questionable if the credit facilitation for piggery is eligible. The professional consultancy on intensification of established as well as diversification of agricultural production excluding piggery might be the more sustainable perspective.

### **5.3.5 Summary and Conclusions of the Economic Dimension**

Due to the Doi Moi's change in social and economical aspects, the farm households seem to underlie the beginning of a bigger transitional process. Subsistence agriculture with an additional non-farm income will continue. In general the farms need to increase in size and/or production intensity including professional training to keep competitive on the market. According to the analysis of economic aspects examined, the following statements are summarized.

- ↪ Agricultural production is mainly dedicated to fruit growing and rice cultivation. About 20 % of OFHs cultivate upland-crops; vegetable gardens are almost not present. The majority seeks 3 rice crops and about 70 % cultivate not integrated and without crop rotation.
- ↪ Off-farm activities are very scarce. By comparison, Non-User-OFHs' have bigger land tenure and outnumber in on-farm activities. The User-OFHs' dominance of non-farm activities might lead to a more continuous income, an important precondition for investment in innovations.
- ↪ On average, 10 % of both User-groups are very poor. In the category of poor with transition to break the poverty line Non-User-OFHs with 37 % almost double the User-OFHs which are represented with 21 %, vice versa to the highest income category.
- ↪ Almost every Non-User-OFH and three quarters of User-OFHs use mineral fertilizer. The investment in mineral fertilizer is about 10 to 30 % of the annual income. Even a partially substitution of mineral fertilizer by organic fertilizer (BGS) is of economical interest.
- ↪ 92 % of User-OFHs raise pigs (in most cases two adult pigs and 10 shoats); 50 % of the Non-User-OFHs own adult pigs and/or a couple of shoats. Hence, more than three quarters of the whole sample has piggery.
- ↪ More than 50 % of both user-groups raise credits (majority accounts over 1 million VND) with the bank (VBARD/SPB) as creditor. However, even the User-OFHs, which dispose of better economic conditions, confirm that it is almost impossible to get a long-term credit for small amounts. Principal information agent to raise credits is the People's Committee (PC). The screening of OFHs' creditworthiness is not standardized and none of the villages offers a special credit or saving program to facilitate the investment in BGP or ML.

According to these results the User-OFHs feature clearly a better financial situation than the Non-User-OFHs. In addition, the present credit conditions seem to be inappropriate in many cases (low poverty outreach; installment schedule). Consequently, most of the User-OFHs having satisfied their basic needs of living standard anyway are in the position to take a risk on their own capital. The User-OFHs' higher tendency to non-farm income sources while maintaining agricultural



production, may even support their disposition for acceptance of the innovations. The Non-User-OFHs, as more dependent on their on-farm income, suffer higher insecurity by the market instability of agricultural products. The value of organic fertilizer seems to be quite low, due to the fact that the cultivation of upland-crops and vegetable gardens are not common; the produced amount of BGS is low and its impact difficult to calculate.

In conclusion, the great majority of OFHs requires more security to satisfy their basic needs and less chancy investment conditions. Therefore an appropriate microfinance system, farmers' professional training and technical assistance are needed.

## **5.4 Cultural Dimension- Common Exposure to Water and Garbage**

In this section, emphasis is put on the description of water and garbage exposure that was supposed to vary due to the cultural background of different ethnic groups. The acceptability and social compatibility of objectives or activities is a further important point closely aligned with traditions, moral concepts and religious orientation in the scope of social integration in the community. The aspects of acceptability or like sometimes called social compatibility have a strong relation to the cultural dimension. But they can only be analyzed in direct observation to an object or action. Therefore this issue appears to be analyzed in each chapter of evaluated innovation.

### **5.4.1 Ethnic Groups**

Knowledge about the composition of different ethnic groups is supposed to be an essential factor for a broad range of explanations on human behavior in a community. The fact that Khmer people, due to religious belief, do not use groundwater for drinking was the only ethnic-related behavior concerning water and garbage found out. In case of this study, the sample of 218 OFHs consists of 213 Kinh, only 2 Khmer and 3 Chinese respondents. Consequently, there is no ethnic basis for significant differences in attitude and acceptance behavior among the OFHs in this area. In other regions e.g. Soc Trang, where more than half of the population is Khmer, this issue should be taken into account.

### **5.4.2 Exposure to Water**

The OFHs in the Mekong Delta live intensively with the subject of water. It is one of the world's largest delta formations. The river system of the Mekong transports many resources down from the Tibetan Plateau along the country borders of Myanmar, Laos, Thailand and Cambodia. Therefore this delta area has become one of the principal locations for agricultural production in Viet Nam (DUONG VAN, SAFFORD ET AL. 2001: 122). Water is the heart of the Mekong Delta. As the water system is tidal, the water level varies everyday. Flooding occurs during the principal rainy season from August till middle of November. The broad network of rivers and canals is used for transportation, a great variety of aquaculture, plant production and industry. Water rules life in this region. Hence, people had to get accustomed to live with all advantages and disadvantages of this special environment.

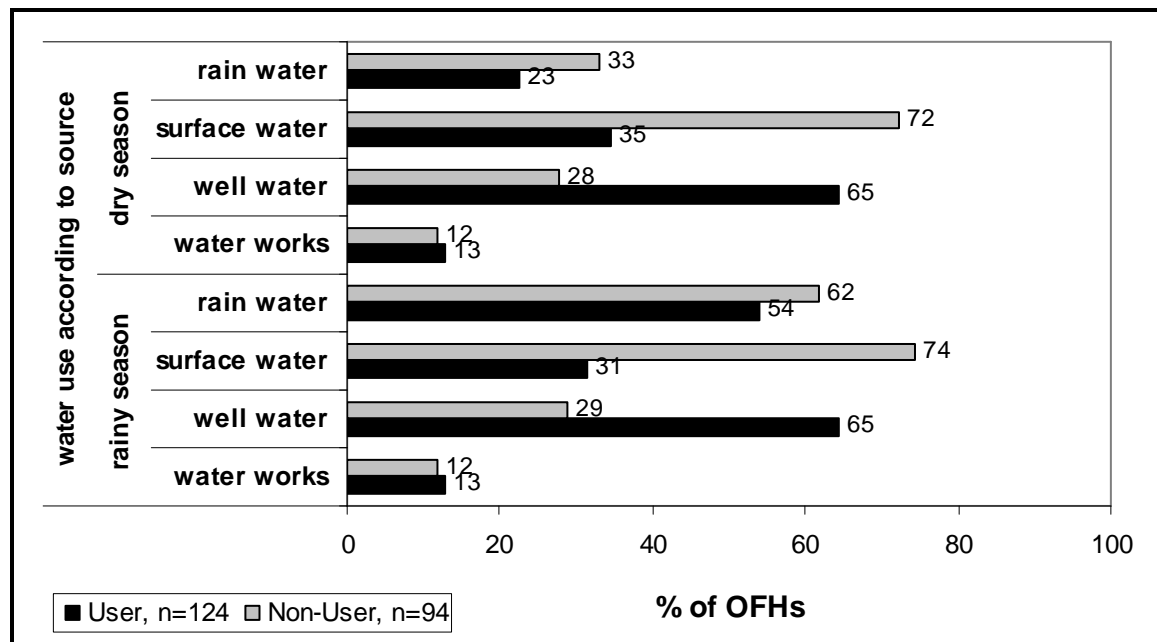
Considering water management on household level, the first question was focused on the consumption of water according to source and season. As the OFHs generally do not live from one source exclusively, multiple entries were common<sup>28</sup>. The results demonstrated in *Figure 5-33* show the higher frequency to use rain water in the rainy

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<sup>28</sup>

**dry season** – Users: 202 and Non-Users: 166 votings;  
**rainy season** – Users: 167 and Non-Users: 136 votings

season. That seems obvious but nevertheless states that rainwater is the preferred source. People esteem the quality and taste of rain water. They know about the problems related to surface and well water.



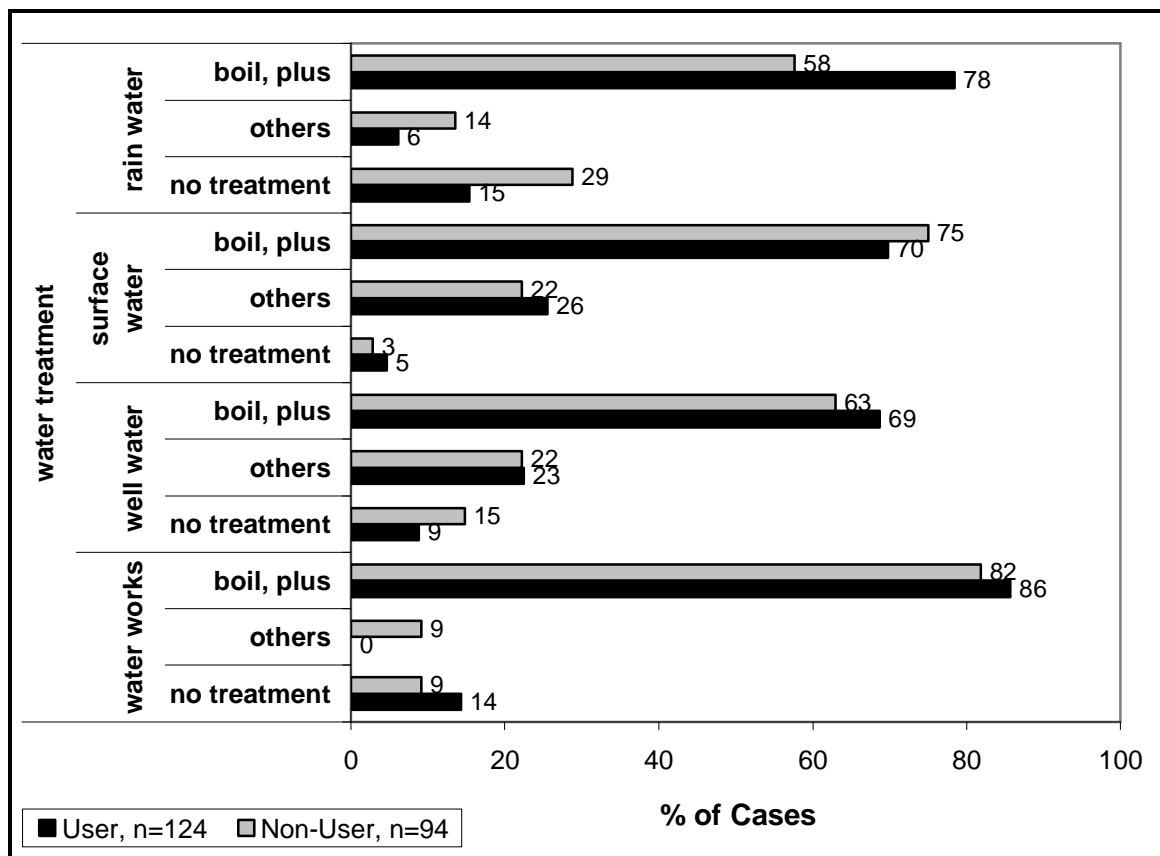
**Figure 5-33 : Users' and Non-Users' Consumption of Water According to Season and Source** (Multiple choice answers)

Most of the households collect part of the precipitation going down on their roof in ceramic jars. But nevertheless only one household could be found where a more sophisticated system was installed to collect rainwater (*cp. Appendix 5-3*). According to the national statistics, less than 8 % of the Mekong Delta population uses rainwater as main water source the whole year around. By comparison, in the Red River Delta it is almost 30 % of the population using rainwater respectively (GSO 2004). As in the Mekong Delta are two rainy seasons, although to different extents, the optimization of water supply should much more concern the collection, storage and treatment of rain water. Furthermore, the study reveals that the double amount of Non-User-OFHs use surface water than User-OFHs do and vice versa concerning the consumption of well water. This leads to the assumption that the latter somehow have better access to a water pump. Apart from economic reasons, essential information could be found in the case of Hoa An. Here the situation of well water is extremely difficult due to high iron and chloride concentration (STOLPE A. NUBER 2005: 2ff). Potable water, if any, is only found in very deep layers. Many of the inhabitants in Hoa An drink well water which in fact is not usable; the quality of the surface water is even worse. Although the quality of groundwater is low, the respondents frequently mentioned the need to get a water pump for their daily usage. Some original comments of the interviewees in *Box 5-1* flesh out their attitudes and knowledge about the situation of water pollution.

- ↪ We need fresh water supply for every household, because the river is polluted and the groundwater is acid. QN192
- ↪ There are some factories which violate the environmental regulations to reduce water pollution. QN138
- ↪ The river water is polluted by animal feces, so people get scabies bathing in it. QN188
- ↪ We need water pumps very much. QN 212/217

**Box 5-1 : Verbal Statements - Water**

Subsequently, the question of actual water treatment according to the used water source is raised. During the investigation on water treatment by the OFHs, a total of 13 varieties/combinations were ascertained. This included principally the treatment by boiling and additionally with filter (ceramic or cloth), aluminum sulfate or chlorine. In order to facilitate a statement about the practiced water treatment and the according hygienic health risk, the varieties were reduced to three categories shown in *Figure 5-34*, distinguished according to the water source.



**Figure 5-34 : Users’ and Non-Users’ Water Treatment for Consumption According to Source**

**Boil, plus** = minimum to boil water, generally safe method; **Others** = filter, aluminum sulfate, chlorine or combination of these; **No treatment** = no treatment at all. Multiple answers were possible.

The statement can only be done on this level because apart from the principal manners of treatment it depends very much on the “how-to-do-it”. That includes the catchments, transport, storage and final treatment. Furthermore, the water quality,

although from the same main source, could vary significantly. This may be founded by the season of year as well as the location's hydrogeology (e.g. Hoa An). In its majority the OFHs boil the water before use, which is a basic but very efficient treatment. Additionally, these OFHs implement another technique before or afterwards for purification of the water and to improve the quality/taste for consumption. The only difference between the OFH-groups' treatment behavior exists in the treatment of rain water. Here it can be supposed that the User-OFHs are more sensitive through better access to hygienic information/education using rain water principally after boiling process. This may be based on received information by the provider/program of the owned installation (Farmer's Union, Women's Union, CTU, international NGOs). Furthermore, the availability of BGP-gas for the boiling procedure might support this behavior.

The results give the impression that the people are aware of the water pollution. This aspect is further analyzed in the chapter regarding the ecological dimension. They know and use a broad range of treatments for water purification. Nevertheless, the availability of water, especially safe drinking water states a problem in many households. In various locations the groundwater use is problematic because of fossil saline groundwater reservoirs. The collection, treatment and storage of rain water should be prioritized and enhanced, even more with the background of bad surface water quality due to existing salt water intrusion, the acid sulfate soils as well as intensive input of mineral fertilizer and other agrochemicals.

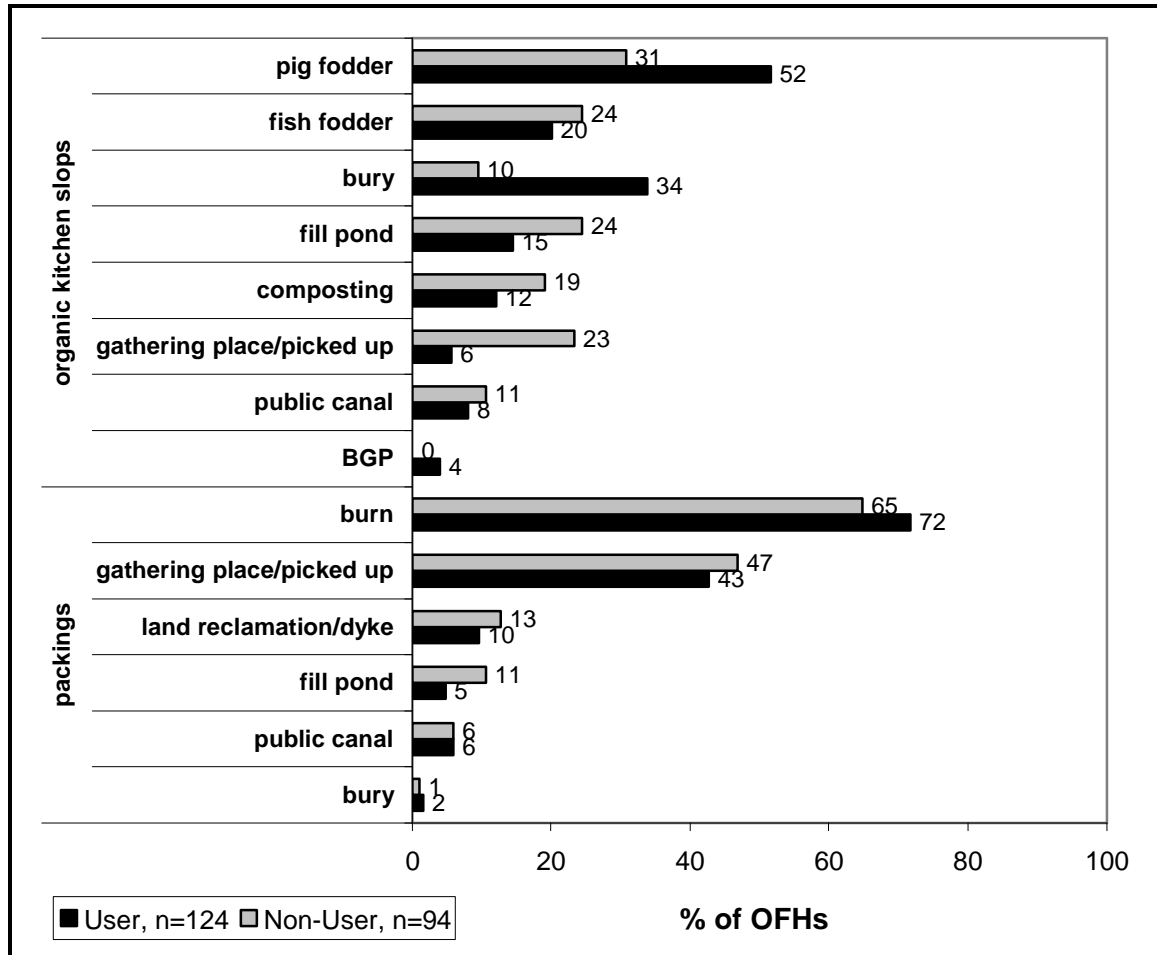
### **5.4.3 Exposure to Garbage**

Generally garbage becomes an increasing problem with the increase of population density, disregarding the country. But exposure and thus, especially constraints in treatment and disposal of waste, increase with the modernization of alimentation habits. The percentage of packed food ascends rapidly in developing countries and furthermore, disproportional to environmental awareness, logistic possibilities and financial conditions of their population. The disposal in a rudimental ecologic way is still a luxury and complex challenge in countries which dispose of using excellent infrastructure. Against this background the situation of the surveyed sites has to be evaluated.

*Figure 5-35* presents the variety of exposure to organic garbage as well as inorganic rubbish by the responding OFHs. Multiple entries were possible and both groups had a relative amount of 2.8 votings. Concerning kitchen slopes, the User-OFHs show low usage for BGP and a significant difference in the behavior to bury it as well as in utilization for pig fodder. The latter concurs with the fact that principally OFHs with piggery invested in BGP.

With regard to the question what the respondents do with inorganic packing, the majority tends to burn it. Nevertheless, the amount of OFHs which use it to fill up the

pond, for land reclamation, put it in the public canal or throw it on a gathering place is serious. During the survey the problem of adequate packing disposal was clearly visible. The frequency of wild dumps increased in the hamlets with higher population density and thus, in suburban direction.



**Figure 5-35 : Users’ and Non-Users’ Treatment of Garbage According to Source** (Multiple choice answers)

In this context the later results of environmental commitments as well as of the investigation on BGS has to be considered to complete the information on the respondents’ exposure to garbage. *Box 5-2* gives an additional impression of the actual situation of the respondents’ exposure to garbage.

- ↪ We burn and burry plastic bottles of insecticides. QN35
- ↪ I fill the pond with rubbish to gain land and encourage other people not to throw it everywhere or in the river. QN138
- ↪ Fill in some puddle around the house for flood protection. QN146

**Box 5-2 : Verbal Statements - Garbage**

Striking is the ambivalent behavior to “fill the pond with rubbish” and at the same time to show the initiative of educating people (*cp. Appendix 5-4*). At first sight there can be seen the logic not to pollute the river and other public places. Further, the

packaging is seen as resource, as building material to stabilize dams, foot paths and others. It is used for land reclamation and thus, somehow recycled in its use. But the pond filling shows the lack of environmental education and/or possibilities to act in a more appropriate environmental way. People seem not to have the long-run view, that they create an environmental health hazard for animals and human beings. On the other hand they notice that especially during the flooding season, the river is heavier polluted by residuals (*cp. Figure 5-43*).

However, in one case a family could be observed collecting plastics to shredder and smelt it for the production of jars and other kind of vessels. The household had a low living standard with their labor principally dedicated to farming activities. The plastic recycle products were an additional non-farm income. This family enterprise shows that as long as the living standard is low and there is the opportunity to make money out of something, people are very prepared and creative to do so. The environmental impact of this activity is only a side effect. The rational behavior dominates in most cases as long as basic necessities are not satisfied. These circumstances indicate that hygienic and environmental commitments first need an economical motivation which is linked to education and capacity building.

#### **5.4.4 Summary and Conclusions of the Cultural Dimension**

According to the analysis of cultural aspects, herein specifically the exposure to water and garbage, the following statements are presented to complete the understanding of the OFHs' objective surrounding:

- ↪ Availability of safe drinking water states a problem in many households. All water sources are used during dry and rainy season. Rainwater is preferred due to good taste. Determining difference is the fact that twice the amount of Non-User-OFHs uses surface water than User-OFHs do and vice versa concerning the consumption of well water because of better access to water pumps.
- ↪ Most current water treatment for consumption is by boiling and an additional treatment with filter (ceramic or cloth), aluminum sulfate or chlorine. Only rainwater is not treated at all, especially in Non-User-OFHs.
- ↪ Garbage becomes an increasing problem with the growing population density. Likewise treatment and disposal of waste increase with the modernization of alimentation habits due to the ascending percentage of packed food in rural to suburban gradient. The OFHs show lack of environmental awareness as well as of logistic possibilities and financial conditions for appropriate measures. Concerning inorganic packing, the majority tends to burn it, to fill up the pond, to use it for land reclamation, to put it in the public canal or to throw it on a gathering place.

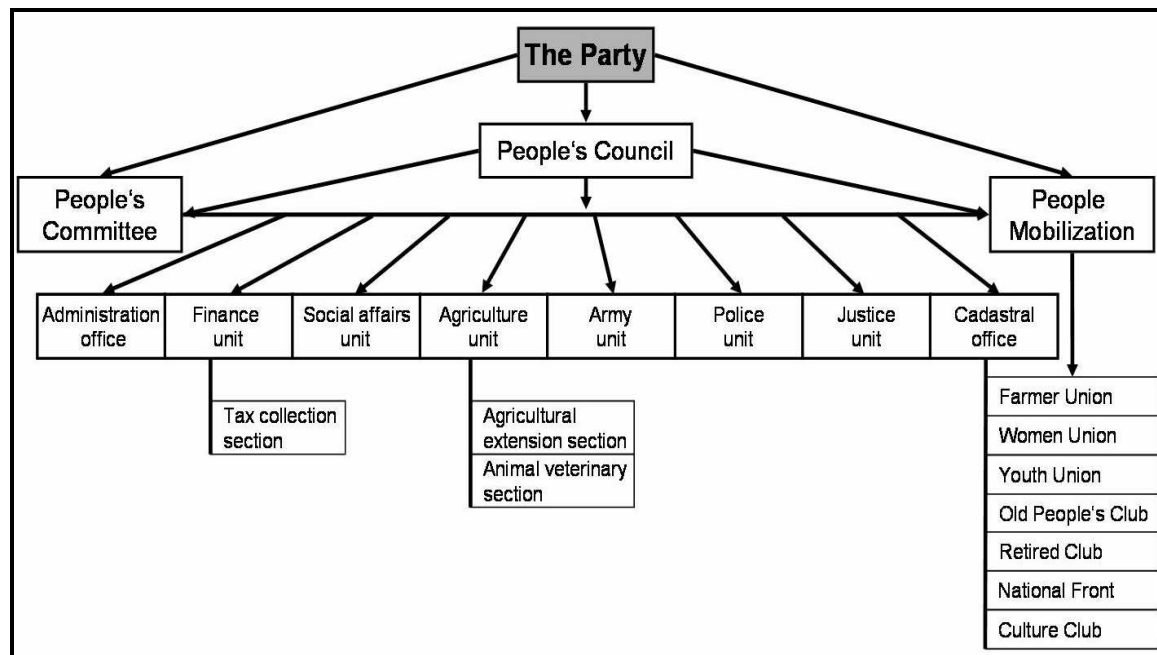
↳ Regarding kitchen slopes, the User-OFHs show low usage for BGP and a significant difference in the behavior to bury it as well as in utilization for pig fodder.

With consideration of the partly critical quality of groundwater and well water as well as the general preference to consume rainwater for drinking due to its taste, the use of rainwater should be enhanced. Priority should be put on improving the water catchments and storage. On the local market sophisticated water-storage tanks are available already. In some cases these might be a more efficient solution for fresh water supply than a well with pump. In regions with significant Khmer population this measure becomes even more important. Considering the OFH-groups, the different exposure to water is principally based on the User-OFHs' higher living standard disposing of a water well. Furthermore, they are more used to boil the water, which may be due to the BGP-gas availability for "free" and/or the involvement in project activities that lead to better information access and education in safe drinking water issues. In conclusion the results on exposure to water and garbage do not have significance for BGP- and ML-acceptance except the hint of hygienic awareness. But it is worth to consider combining the introduction of BGP, ML and sophisticated rainwater storage tanks.



## 5.5 Political Dimension – Governmental and Institutional Influences on Framework for New Technology Introduction

The Socialist Republic of Viet Nam has an institutional “soviet-style” structure which is typical for a social-(communist) country. Head of all administrative levels is the Communist Party of Vietnam (CPVN). *Figure 5-36* illustrates the government institutional arrangement at village level. The understanding of the institutional network is essential for the survey concept to analyze the farmers’ life and hence, the basis for any recommendations on project measures (CTU 2002: 8).



**Figure 5-36 : Organization Chart of Local Government**

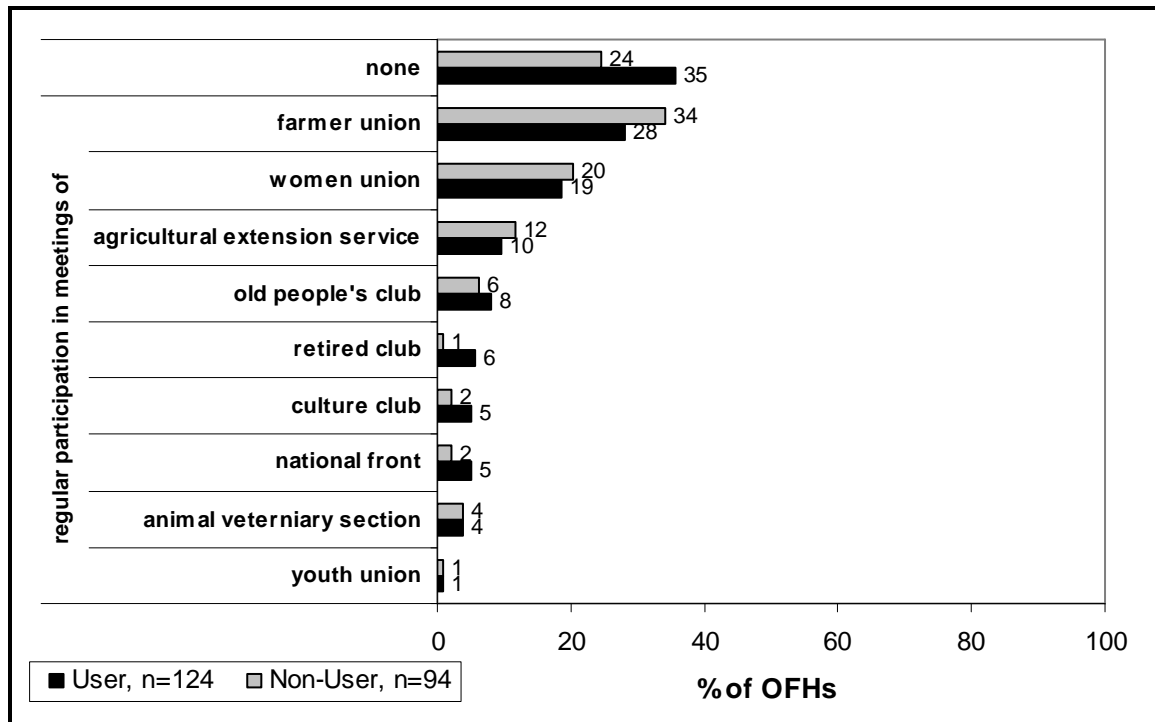
Principally the People’s Committee, the Agriculture Unit with its sections and the mass organizations for people mobilization are supposed to be core institutions for information access and transmission as well as technical assistance on introduction of innovations. According to this assumption the mentioned units and organizations were involved in the survey.

### 5.5.1 Political Institutions

The investigation of the political dimension’s importance for attitude and acceptance behavior is basically structured in two parts. First, the OFHs’ distribution of active membership according to the mass organizations as well as the active membership and kind of office in the CPVN is examined. Furthermore, the knowledge about policies referring to the substitution of untreated feces use and of traditional fishpond-latrine use and its information channels are evaluated.

In the following *Figure 5-37*, presenting active memberships according to the organization, it has to be kept in mind that multiple entries were possible. However, about one-third of the respondents are not regularly participating in meetings of one

of the local mass organizations. Furthermore, the Non-User-OFHs seem to be more active especially in the key organization like Farmer's Union, Women's Union, Extension Service and Animal Veterinary Section. This seems to contradict the hypothesis that the User-OFHs are more actively involved in the mass organizations and thus, could dispose of better information access and resources. Further, the dedication to non-farm activities (*cp. Figure 5-20*), specifically in the case of User-OFHs, might be an explanation for this relatively low rate of active membership.



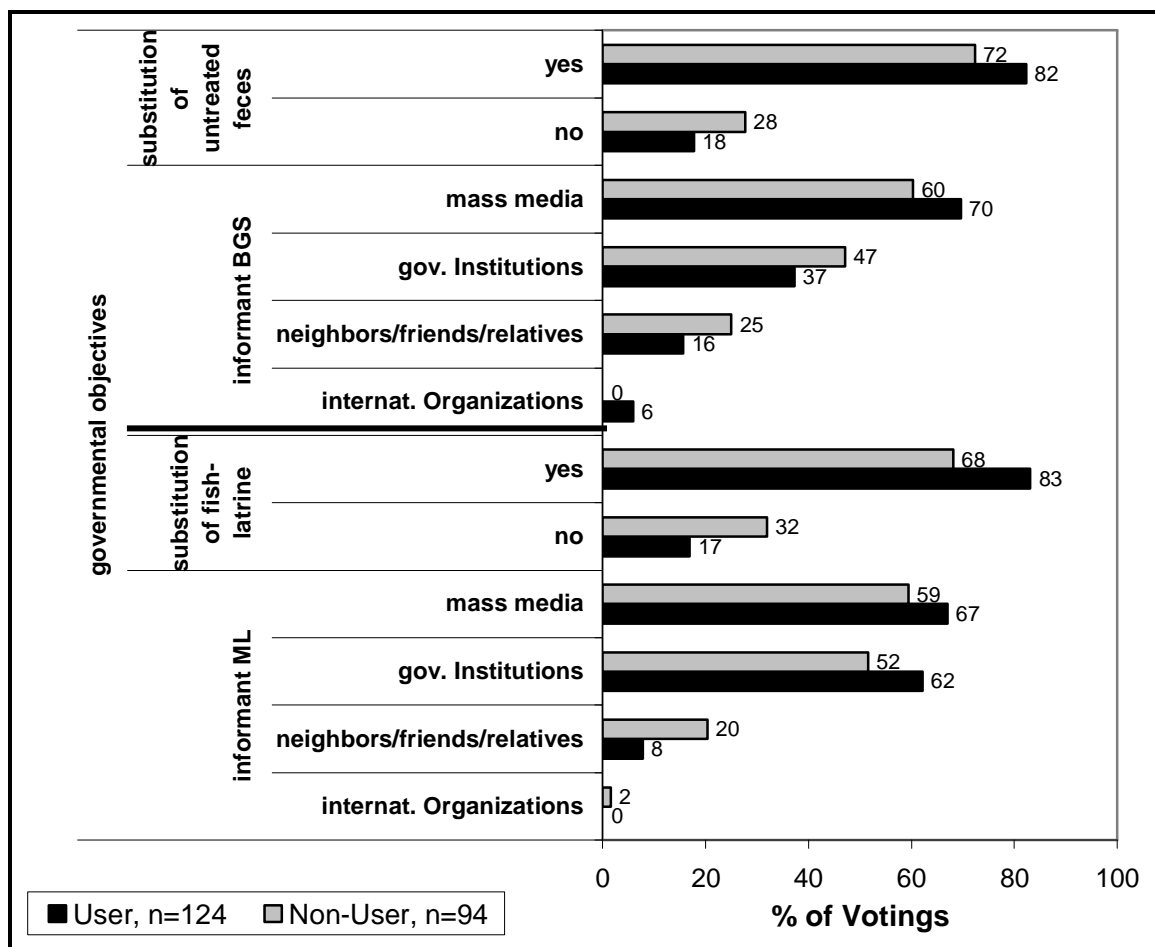
**Figure 5-37 : Active Membership of Users' and Non-Users' in Local Mass Organizations** (Multiple choice answers)

The aspect of information access, especially the question of the first informant will be followed within the chapters regarding each innovation. The general information gives no hint on the importance of active membership in certain mass organizations for acceptance behavior. In addition the membership and possibly hold office in the CPVN of the respondents was evaluated. Contrary, here a significant difference in terms of active membership in the CPVN in favor of the User-OFHs with 26 % versus 4 % of the Non-User-OFHs is found and the majority holds leading offices. This fleshes out that a close relationship to the political network might facilitate access to information and resources and/or influences the decision making of the OFHs.

### **5.5.2 Communication Channels of Governmental Intentions and Regulations**

In recent years the continuous development and progress of the "Doi Moi" movement implies new intentions and regulations on all sections of life. Due to this, the GoV approved the NRWSS in the year 2000 (*cp. Chapter 3-2*). In this scope, the two issues, to ban fishpond-latrines and the use of untreated feces were surveyed. Thus,

the knowledge of the planned substitution by modern latrines and organic fertilizer respectively was checked. *Figure 5-38* illustrates that 70-80 % of the OFHs know about these governmental intentions; User-OFHs are ahead few percentages to the Non-User-OFHs. Principal communication channels according to their priority are mass media, PC institutions and the direct social environment. The latter seems to have higher importance for the Non-User-OFHs and it needs to be mentioned that this is congruent to the principal communication channel and demonstrator for reliable information about BGP and ML (*cp. Figure 5-45 / 5-61*). Obviously the political intentions are transmitted principally by mass media and governmental institutions to the “Innovators” (according ROGERS).



**Figure 5-38 : Information Transmission and Influence of Governmental Intentions on Users' and Non-Users' Attitudes** (Multiple choice answers)

But the Non-Users (following groups in the diffusion process) require on-hand information by persons of confidence residing in their direct social environment. In conclusion, the results show that a considerable number of OFHs holds an active membership principally in the Farmer's and Women's Union, although the User-OFHs do not overweigh in this aspect. Regarding the relation to the CPVN, the active membership seems to have a significant value for investment and acceptance of the innovations. The information on the two surveyed governmental issues on sanitation

and hygienic safety are widely spread. The mass media is confirmed to be the mostly used mean of information transmission with regard to the analyzed governmental intentions. According to the User-OFHs' media availability (*cp. Figure 5-10*) they prevail in its use. The governmental institutions/mass organizations occupy the second place with high percentage. Here, the subject of fishpond-latrine elimination seems better communicated than the topic to use organic material instead of untreated feces. The direct social contacts as well as international NGOs play a minor role in these aspects, specifically for the User-OFHs.

### **5.5.3 Summary and Conclusions of the Political Dimension**

The analysis of the political dimension with emphasis on the political and institutional network on community level and of the political influence on water and sanitation issues reveals the following major results:

- ↪ About one third of the OFH are active members of the Farmer Union, Women Union or Agricultural Extension Service.
- ↪ Principally, mass media, the People's Committee, the Agriculture Unit with its sections and the mass organizations for people mobilization are core institutions for information access and transmission as well as technical assistance on introduction of innovations.
- ↪ User-OFHs dominate significantly in terms of active membership in the CPVN and the majority holds leading offices.
- ↪ 70 to 80 % of the households know about the governmental intentions to substitute fishpond-latrines and to promote the use of organic fertilizer instead of untreated feces. Principal communication channels are mass media, PC, especially for User-OFHs, whereas in case of Non-User-OFHs direct social environment seems to have higher importance for information access.

The implementation of the NRWSS needs consistent and efficient communication of its policies in order to create confidence and reliability in the population and to enhance acceptance and dissemination of new technologies.

The institutional and political network is strong and offers a good platform to communicate water and sanitation issues. Most of the OFHs have at least heard of the political intentions principally by mass media and mass organizations. The User-OFHs seem to be slightly better informed and more active in the CPVN. But the latter is not significant for the great majority's acceptance behavior. In fact, this fits to the characteristics of Innovators and Early Adopters. But for the Non-Users, the later groups of the diffusion process with more doubts require both, official information channels to set the framework and in-depth information by confidants to establish a positive attitude as vantage point for acceptance to use.

## 5.6 Medical Dimension – Hygienic Situation as Possible Motivation for Acceptance

The hygienic safety of the organic material is a key issue and core problem reusing wastewater. In Viet Nam's rural area it is part of the Chinese rooted tradition to use night soil (untreated human feces) as fertilizer in agriculture. But the use of untreated excrements bears the spread of diseases, especially in flood prone areas like the Mekong Delta. In projects to improve the sanitary infrastructure as in the case of ecological sanitation projects it was found out that hygiene, water protection and economy are perceived as most important criteria, followed by reliability, sociological aspects and responsibility (KVARNSTRÖM A. PETERSENS 2003: 25). Thus, these arguments are used to promote this kind of projects. Therefore, people need to develop hygienic awareness, which in most cases requires education and capacity building in hygienic and environmental aspects and behaviors. The issue of hygienic awareness is emphasized as well in the studies of ADCOM (2002: 8f) and MUKHERJEE (2001: 12ff) as the principal base for sustainable sanitation projects. Accordingly, the NRWSS states strongly the necessity of mass education campaigns to improve the hygienic awareness and practices in the community.

### 5.6.1 Hygienic Awareness

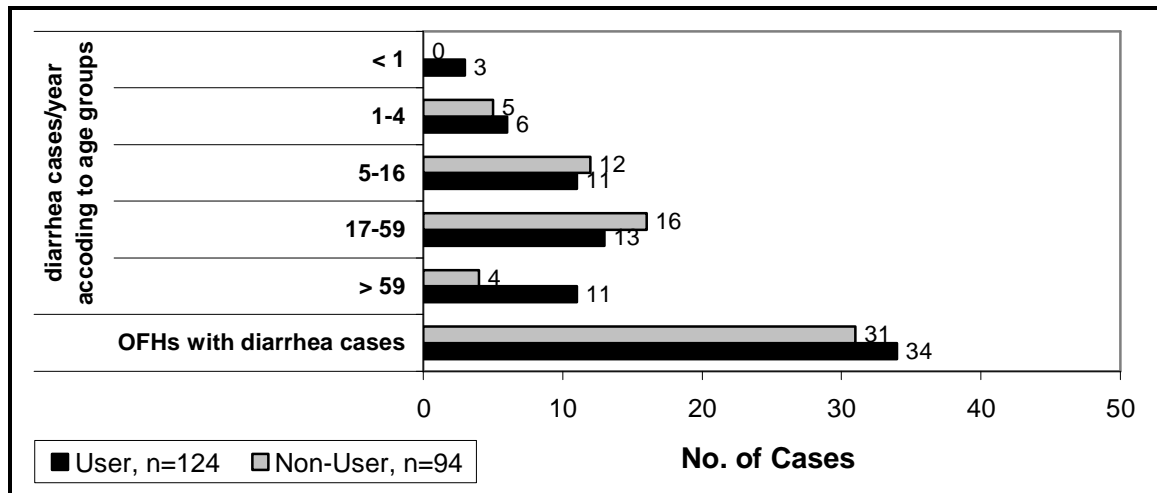
In its first step hygienic awareness is generated by people's experience. In the *Box 5-3* some verbal statements recorded during the interviews express examples of people's recognition regarding their health.

- ↪ During the flooding season the diseases spread. QN163/173
- ↪ When we take a bath in the river during the flooding season, we get itchiness because the water from paddy drains into the river. QN177

#### **Box 5-3 : Verbal Statements – Hygienic Awareness**

These comments give a clear impression of the hygienic problems people have to face in their everyday life but especially during the flooding season.

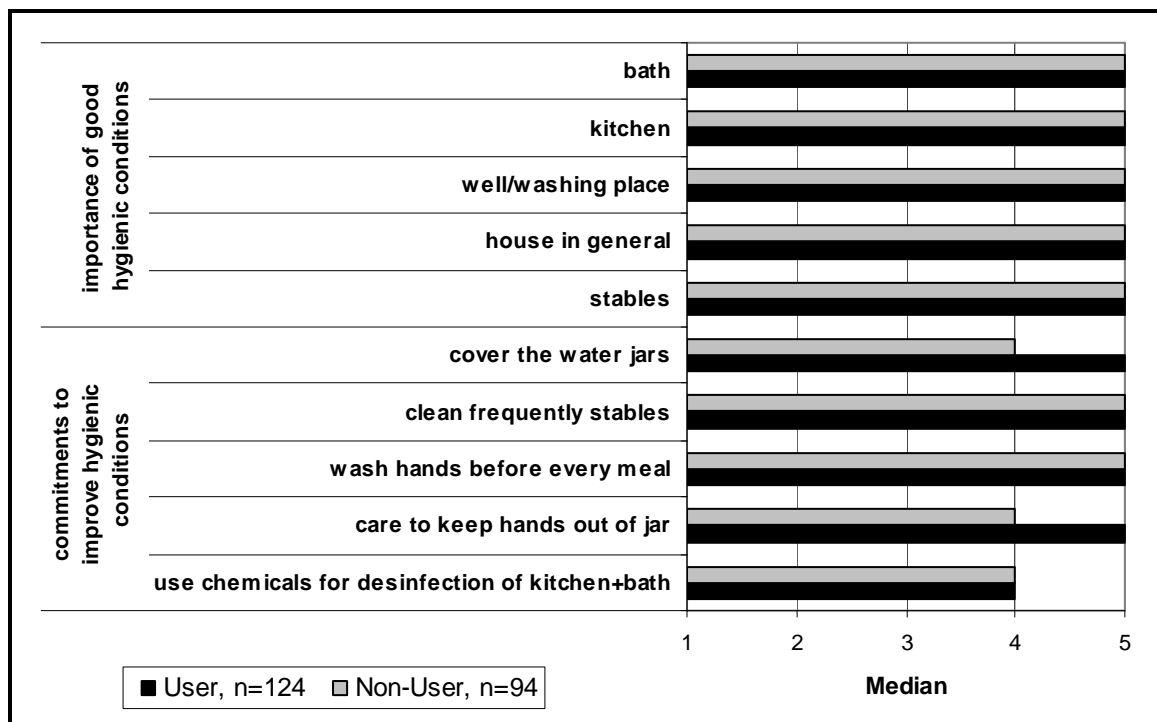
Diarrhea is one the major waterborne diseases, specifically in tropical countries all over the world. According to the WHO country health information profile 167,077 diarrhea cases were recorded in Viet Nam for the year 2002. Therefore diarrhea takes fourth rank of causes for morbidity and tenth rank for causes of mortality in Viet Nam (WHO 2004: 399f). Reference data were only available on national level and it should be taken into account that these are only the officially recorded cases. *Figure 5-39* illustrates the amount of OFHs with diarrhea cases and the number of cases according to age category. With regard to the national statistic, the amount of diarrhea cases occurring in the OFHs of the research sites seems surprisingly low.



**Figure 5-39 : Users’ and Non-Users’ Diarrhea Cases According to Age**

About one-third of the OFHs comment that diarrhea occurs. As the demographic distribution in age of the User- and Non-User-OFHs is almost identical (*cp. Figure 5-5*) no further conclusions can be drawn. These results can only be an approximation as the information is achieved at one point in time relying on the respondents’ memory concerning a one-year period. However, the health education requires data and practical demonstrations in order to make the necessity more comprehensible for the OFHs. Subsequently, this issue will have increased value for the introduction and diffusion of BGP and ML.

The *Figure 5-40* resumes the results of the assessments on the importance of good



**Figure 5-40 : Users’ and Non-Users’ Importance and Commitments for Good Hygienic Conditions**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

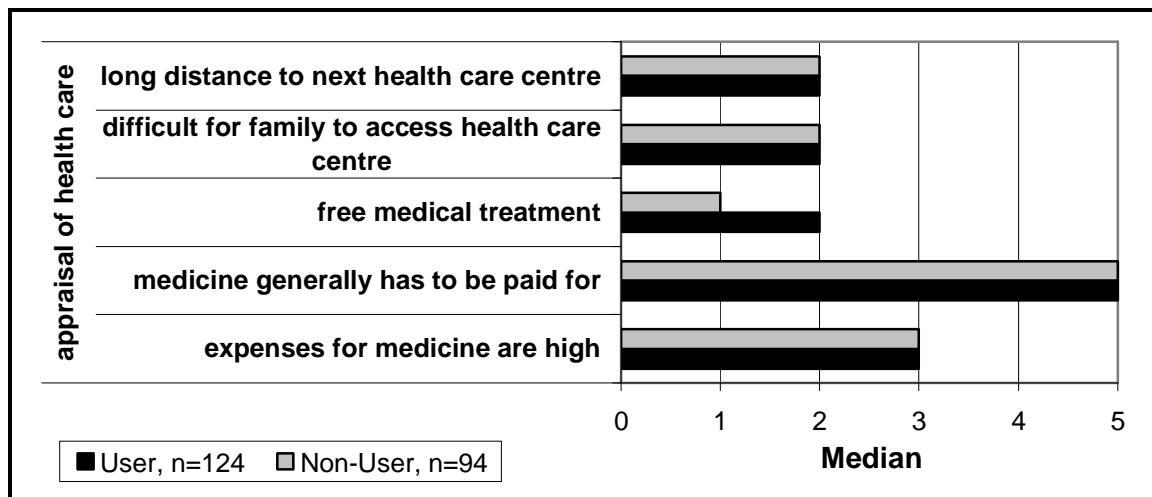
hygienic conditions in different locations of the OFHs and the commitments to improve these conditions. The illustration by median shows, that almost all aspects receive the highest category. Going into detail no subgroup could be detected. Instead, all aspects with the median of category five (absolutely true) are based on more than 90 % of the OFHs' appraisal of category four or five.

In relation to the low number of occurring diarrhea cases these responses fit. Both OFH-groups value good hygienic conditions at all listed place with the highest importance. Even more important are the statements referring to corresponding commitments. Here, the User-OFHs prevail in the two behavioral aspects on water jar use. But in general all selected commitments to improve the hygienic conditions receive high value.

Nevertheless, the personal observation and photographical documentation shows a broad range of situations: In many cases well/washing places are in bad conditions, due to dumped garbage or simply lack of a separated place at all. The water jars are not covered frequently. The important aspect to avoid hand contact could not be observed. Additionally, it is worth mentioning that in several cases of PE-BGP-Users, the effluent accumulates in a basin without drain. The mosquitoes find excellent breeding conditions very close to the dwelling (*cp. Appendix 5-4*). This causes a hygienic threat in particular with regard to vector-transmitted diseases (dengue fever, Japanese encephalitis and malaria). Consequently, the hygienic awareness is high, but the results concerning commitments have to be treated carefully. Due to the discrepancy of statements and observation, it can be supposed that these results are strongly influenced by social desirability.

### **5.6.2 Health Care**

Following the assessment of hygienic awareness the question arises for further pushing factors for real commitments. The efforts needed to access health care stations as well as its costs are possible key factors for corresponding action. *Figure 5-41* demonstrates a selection of assessed statements covering these two aspects. In relation to health care access the respondents stated to need rather low efforts. Thus, the infrastructure and service in times of distribution seems to be good. But the assessment of the economic aspect is likewise explicit. The medical treatment is in most cases not free, medicine always has to be paid for and the expenses for medicine are perceived as rather high. Due to the changes of governmental policies the social privilege of completely free health care including treatment and pharmaceutical provision is not realizable any more.

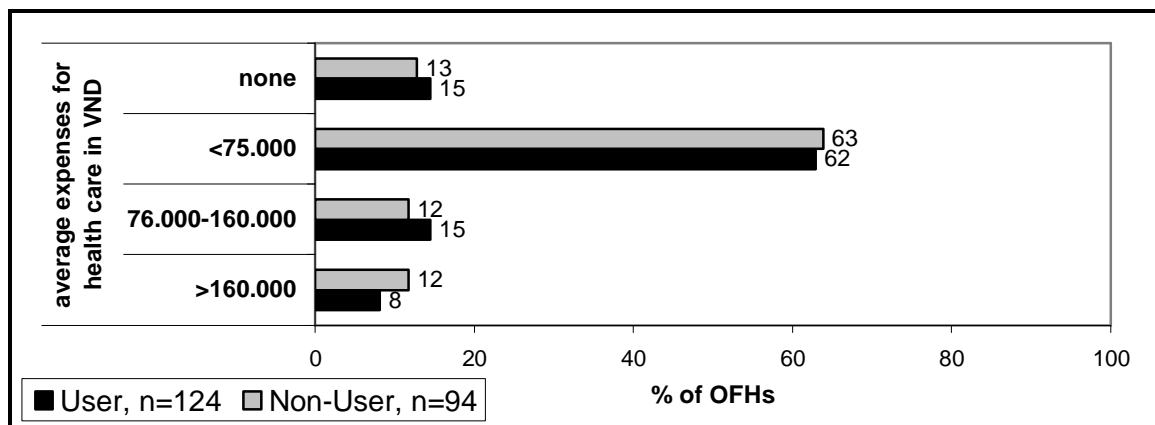


**Figure 5-41 : Users' and Non-Users' Appraisal of Available Health Care**

In this Figure the case occurs that the Median has the value of one. To show this case the scale had to be put down on zero.

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

In recent years the GoV started to introduce health insurance cards, but only to families whose members have an average monthly income below 50,000 VND. Additionally, the insurance is still in its first steps and not consistent. Up to now, the information did not reach all the affected OFHs (UNDP A. AUSAID 2003: 39). As the improvement of hygienic conditions is one important effect of the use of each innovation and even higher in its linked system, the reduction of health care expenses might be a facilitating factor for acceptance. Thus, *Figure 5-42* reveals the average monthly expenses per OFH.



**Figure 5-42 : Users' and Non-Users' Average Expenses for Health Care**

The differences between the user groups are insignificant but it shows that over 60 % of the households have monthly expenses of up to 75,000 VND, and 20 % have even more. In relation to the average OFH income (*cp. Figure 5-19*) this amount covers up to 20 % of the OFHs' available financial resources. Accordingly, apart there could be from the health aspect a related economic motive for the acceptance of the focused innovations. But to make this factor present it requires the enhancement of knowledge and conscious about hygienically safe practices by means of health



education especially in the every-day life of the household as it is aimed within the NRWSS. This rough approach on hygienic awareness and health care conditions indicates that the situation is not bad, although the responses on importance of hygienic conditions and according commitments differ to what could be observed in many locations. Combined with the results on exposure to water, the OFHs seem to have already received health education. Contrary, the information on exposure to garbage has shown that there are many things left to improve. In the next chapter related issues are evaluated in detail. However, the social system has changed to people's participation in expenses for health care. If by means of education and capacity building it can be transmitted that the use of the innovations may reduce waterborne diseases and thus, the costs respectively, the acceptance and dissemination rate might increase.

### **5.6.3 Summary and Conclusions of the Medical Dimension**

The analysis of medical aspects leads to the following major statements:

- ✎ In the rainy season areas get flooded and a lot of rubbish is released into the river, in the dry season there is increasing pollution by pesticide and fertilizer residues. Diarrhea cases seem to be low but scabies and other skin diseases are notably recorded. The OFHs' hygienic awareness is high as well as the accordingly mentioned commitments of prevention, although the observations lead to the assumption that the realization of hygienic practices is still low. For the PE-BGP-Users with accumulation of effluent in basins close to their house, appropriate solutions have to be found in order to avoid possible health risks.
- ✎ The availability and access of health care is perceived as good but free service is almost completely abolished. Two-thirds of the OFHs spend up to 75,000 VND/month for health care and appraise their expenses as high. Thus the demand for improvement of sanitary infrastructure is high.

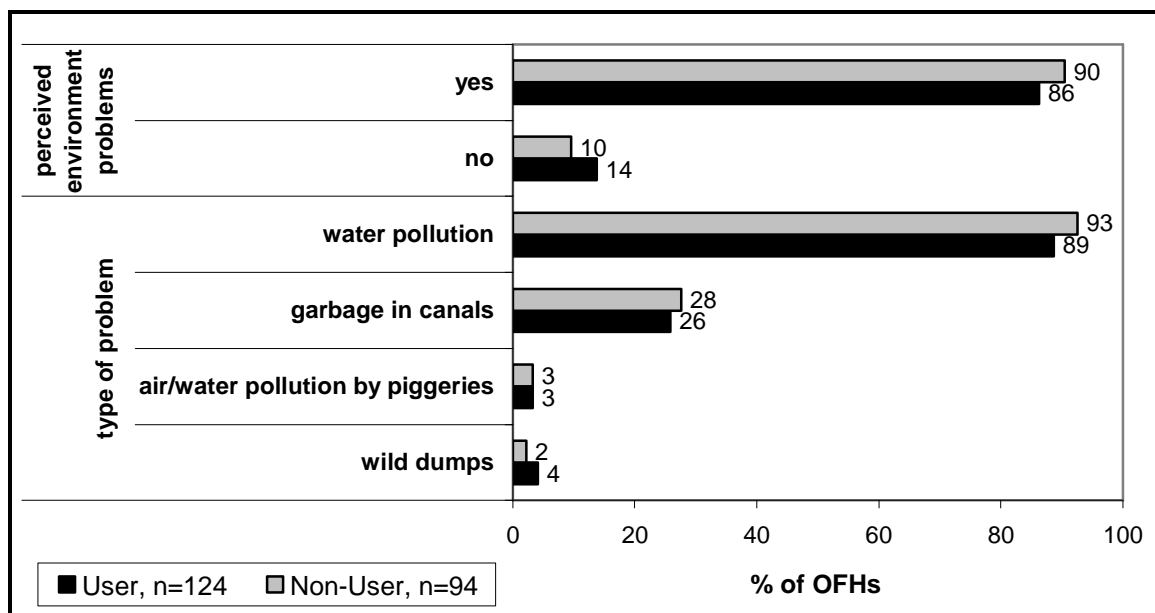
In conclusion the results reveal a rather high hygienic awareness of both OFH-groups; probably the first progressive results due to the initiatives defined in the NRWSS. The importance of hygienic conditions is confirmed, although the discrepancy between statements and commitments is high, indicating the responses being influenced by social desirability. The general health care conditions are perceived as good but related to increasing costs due to the Doi Moi policies. Hence, the poverty outreach shows deficiencies. This aspect could be used as pushing factor for acceptance in case that the OFHs relate the innovations directly to prevention of diseases and therefore costs reduction. Consequently, this preventive impact of the innovations should be strongly communicated, supported by further health care education with practical advices.

## 5.7 Ecological Dimension – Awareness and Commitments for Action

Within this dimension the environmental awareness and realized commitments are analyzed following the structure of perception, attitude and action. Thus, it is closely linked to the cultural and medical dimension to complete the basic information concerning water and garbage serves as a further information piece for the analysis on BGS use. Nutrient and water recycling are commonly used to promote ecological sanitation, but KVARNSTRÖM AND PETERSENS (2004: 25) state that these aspects on average are not perceived as very important. Though, hygiene was the most important criteria followed by water protection, economy, reliability and other sociological aspects. In this Chapter the hypothesis to be verified is that the User-OFHs show a higher environmental awareness as well as according commitments.

### 5.7.1 Environmental Awareness

First of all, the question rises whether environmental problems in general are perceived by the OFHs and secondly, of which kind they are. *Figure 5-43* shows that the perception of about 90 % of the OFHs is very high and that there is no significant discrepancy between the household groups. Water pollution including garbage in canals clearly dominates. The annoyance of air/water pollution is limited to a few cases and the percentage of OFHs which perceive wild dumps is also very low. Referring to this, it should be mentioned that the emphasis is on “wild”.



**Figure 5-43 : Users' and Non-Users' Perception of Environmental Problems** (Multiple choice answers possible)

Due to the observation it can be stated that the amount of dumped garbage is very high (*cp. Appendix 5-4*). The reason for the low perception bases on the fact, that in most cases, garbage is dumped on their properties and not perceived as dumping with negative impact on the environment. Regarding these results, the statement of QN119 shown in *Box 5-4* is quite astonishing. On the one hand it is easily

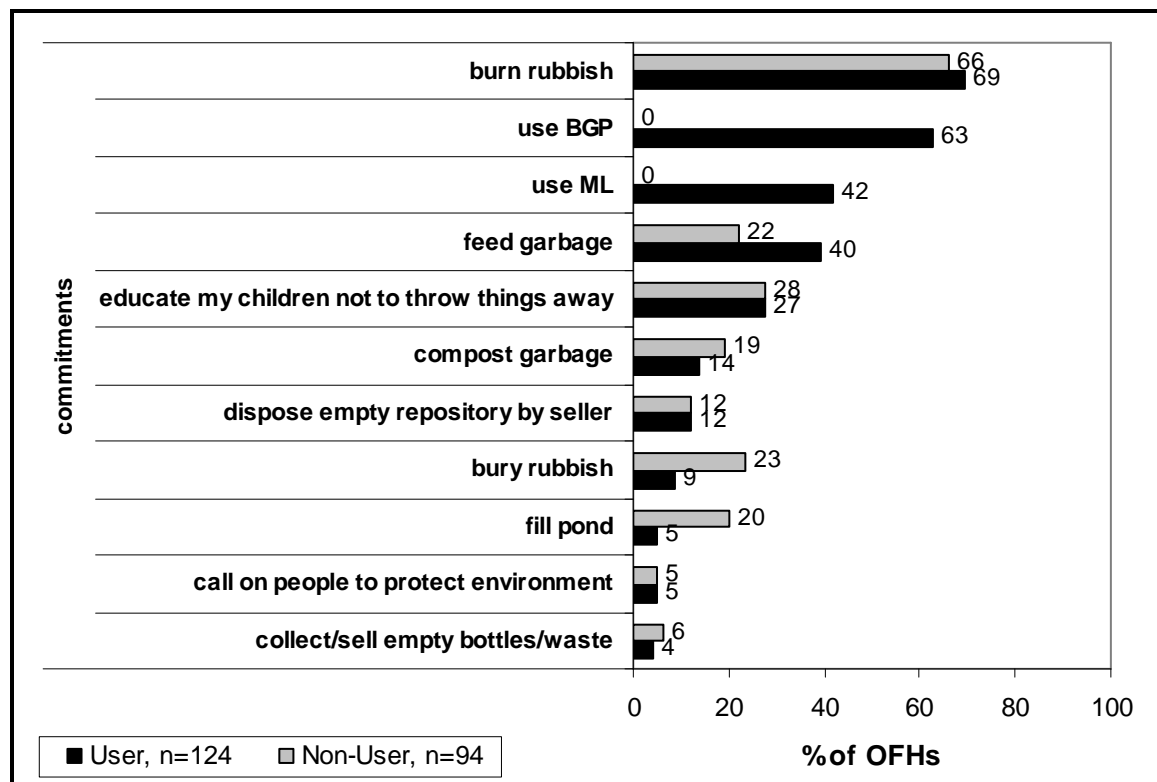
understandable as the readiness for environmental awareness requires a certain level of satisfaction e.g. regarding basic needs of alimentation, living conditions and human rights.

- ↪ The majority of farmers are poor so their environmental conscious is not high. QN119
- ↪ We have the need to develop projects with BGP and linked ML to keep good environment. QN24

**Box 5-4 : Verbal Statements – Environmental Protection**

Otherwise the majority of respondents esteems and shows a high rate of environmental awareness and understanding of the environmental problems in their location. The second common statement gives an impression of the transferred information/perception to the expression of required commitment. It is result of the communicated governmental intentions (*cp. Chapter 5.5.2*)

On the question, whether the respondent is endeavored to keep his environment clean, the household heads of both user-groups declared by 100 % that they make efforts to do so. As a result, *Figure 5-44* reveals conducted activities, the OFHs specify as commitments to avoid environmental pollution.



**Figure 5-44 : Users' and Non-Users' Commitments for Environmental Protection** (Multiple choice answers possible)

As multiple answers were possible, the first important difference appears in the relative amount of statements. With an average of almost three statements per OFH the User-OFHs account one more than the Non-User-OFHs do. Together with the

statements to use BGP and ML in order to protect the environment, it can be assumed that the User-OFHs have a higher environmental awareness. This may be traced back to better information and environmental education in the scope participating in meetings of one of the mass organizations or activities by projects of the CTU and international organizations, or simply reasoned by social desirability. Fitting as well to this conclusion is the fact that about one quarter of the Non-User-OFHs mentioned to bury inorganic rubbish or to fill it into the pond. This way of land reclamation and consolidation of dikes and upper levels which was also mentioned in the chapter referring to garbage treatment is unsustainable and has not much in common with environmental protection. But the respondents perceive it like that, because it is their habit to keep it out of public places and access. Nevertheless, the great majority of both OFH-groups burn the rubbish which is in alignment to the governmental policies, present infrastructure and corresponding opportunities one of the best manners of disposal. Furthermore, it is possible to sell or use the material with some kind of value. Last but not least, more than a quarter of the respondents of both groups mention as environmental commitment to teach their children not to throw rubbish everywhere. Keeping in mind the educational level and living conditions of the families, this fact gives hope for the future generation.

### ***5.7.2 Summary and Conclusions of the Ecological Dimension***

According to the analysis of ecological aspects it can be summarized that:

- ↪ The environmental awareness is with 90 % of the respondents high and is principally concerned to water pollution caused by different contaminators, especially by garbage and pesticides in the canals. The increasing problem of garbage from rural to suburban area (population density, change of consumption habits) is evident, but there is little own initiative to change the situation.
- ↪ User-OFHs identify BGP and ML use as valuable environmental commitment, but the “filling-up of fishpond with inorganic garbage” is perceived likewise with its majority of Non-User-OFHs.

Water and garbage issues seem to be of high priority as the OFHs are aware of the principal problems. But independent initiatives for commitments are still weak in case of both OFH-groups. At this step one can get the impression that people need guidance and support by an institutional community network that efficiently organizes activities such as clear information transfer, capacity building on an appropriate platform as well as the monitoring of regulations. These results lead to the conclusion that apart from education and capacity building it would be necessary to establish an official garbage collection organized by the local government and incorporating the local population.

## 5.8 Biogas Plant – Perception of Attributes for Acceptance to Use

This Chapter deals with the acceptance and use of BGP in detail. Thus the analyzed groups are split into BGP-User (n=98) and BGP-Non-User (n=124). The defined parameters will be described and analyzed to excerpt in each paragraph the most important repressive and/or conducive factors for the acceptance of BGP. As BGP is part of the evaluated system, it will be reviewed in relation to the other innovations. However, first of all the attention will be paid to the BGP construction standards according to the principal project initiated by the FAO in cooperation with the University of Agriculture and Forestry in Ho Chi Minh City in the year 1992.

### 5.8.1 Recommended BGP Construction Standards and their Background

The standards described below are based on long-term experience in various tropical and subtropical countries (DUONG A. LE 2002: 1ff). According to the information of Mr. Duong Nguyen Khang<sup>29</sup> the original construction of a 10 m<sup>3</sup>-size BGP costs 800,000 VND. This includes a three-layer sludge tank (PE), two burners, tubes and connections, a condensation bottle, as well as a two-layer gas tank (3-4 m<sup>3</sup>). The recommended protecting concrete base with coverage requires an additional investment of 700,000 VND. Recently the more expensive Polypropylene (PP) offers a variation for more durability of the tanks but with higher investment costs.

Material	USD/Kg	UV resistance	Duration in years
Polyethylene (PE)	1	regular	4-7
Polypropylene (PP)	2.3	high	10-15

**Table 5-1 : Comparison of Materials for Tube-BGP**

For the fabrication, 1 Kg of PP/PE is sufficient to produce film for 1.1 -1.2 m<sup>3</sup> sludge tank (film thickness: 2.2 mm) or 1.8 m<sup>3</sup> gas tank (film thickness: 1.8mm).

Since 1992 more than 40 provinces in Viet Nam as well as the countries of Cambodia, Lao, Philippines and Thailand have been involved in the project to transfer plastic film BGP. In the case of Viet Nam, the introduction and distribution is managed through a network involving representatives of the GoV, Universities, the Provincial Department of Technology and Environment, the Department of Rural Development as well as the Extension Service and Mass Organizations (Farmer's Union, Women's Union). This seems to be an efficient approach for the dissemination. But the survey shows a remarkable difference in the distributed numbers even between the South-Eastern region (year 2000: 2,790 BGP) and the Mekong Delta (year 2000: 424 BGP) (DUONG A. LE 2002: 4f). Conflicts and partial breakdown of the network in the Mekong Delta were the aftermaths. The reason for

<sup>29</sup> Expert-Interview: Mr. Duong Nguyen Khang is the principal representative of the Biogas Center, University of Agriculture and Forestry, Ho Chi Minh City in the cooperation project to introduce BGP in Viet Nam, which started in 1992.

this does not rely on a lower number of OFHs dedicated to piggery, which could be estimated because the promotion of BGP based definitely on this single aspect. So the question arises, why and how could this happen.

But the background for conflicts and partial breakdown of the network in the Mekong Delta was provoked by a break with quality standards and probably other killing factors. The OFHs' lack of capital stimulated local representatives and individuals to reduce the investment costs drastically by the reduction of layers and/or utilization of local plastic products and other alternatives with insufficient quality. Investment costs were reduced to 500,000 VND and less dependent also on its size. This implicates on the one hand the network damage but even worse, a resulting bad reputation referring to durability and reliability of the new technology. This information is a core factor for the understanding and further interpretation of results in the following paragraphs.

### **5.8.2 Basic Attributes and Conditions of BGP in the Research Area**

Within the total of 218 OFHs in the three research sites, 98 OFHs use a BGP. Thereof 72 are Polyethylene-BGP and 26 Concrete-BGP models. The distribution of BGPs concerning model and quantity is very different. Additionally, it should be mentioned, that in the case of Hoa An and Long Tuyen apart from the selected units no more OFHs using BGP could be found.

<b>BGP-Model</b>	<b>Hoa An</b>	<b>Long Tuyen</b>	<b>An Binh</b>
CC	0	15	11
PE	27	4	41

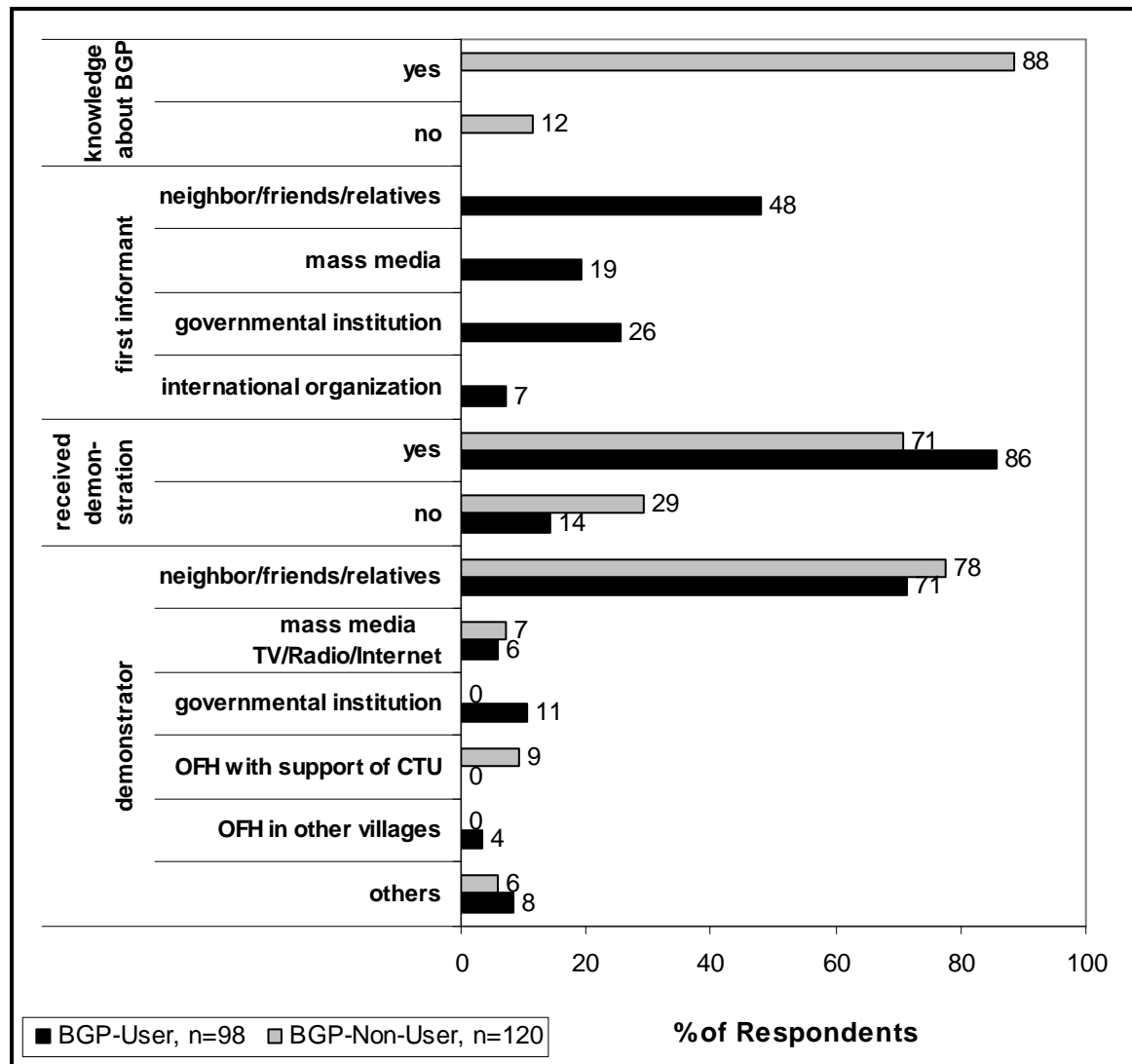
**Table 5-2 : Distribution of BGP According to Villages**

This fact of unequal distribution may help to clarify major factors for acceptance behavior of BGP.

Before one's attention is turned to the assessment of reasons for and against the investment and use of BGP, the aspects of information access, financing and management of BGP are evaluated.

#### **5.8.2.1 Information Access**

Good information access is the key for attitude formation and further decision process of acceptance behavior. *Figure 5-45* illustrates that the majority of respondents know about BGP and even received some kind of demonstration of the installation. Concerning the first contact with an informant or receiving on-hand information by a demonstrator, the access by direct social interaction clearly dominates in case of both OFH-groups. In addition, the BGP-Users' answers show a significant importance of mass media as well as of governmental and international institutions (the introducing entities) for first-hand information.



**Figure 5-45 : BGP-Users’ and BGP-Non-Users’ Knowledge and Information Access for Use of BGP**

This is characteristically for the “Innovators” according to ROGER and thus, supporting the theory of diffusion. Accordingly, the BGP-Non-Users prevail in using confidants of their direct social environment as well as the innovators’ OFHs (OFHs with support of CTU) to receive in-depth information.

With regard to these results of information access and communication channels *Box 5-5* provides an original tone of a household head to underline the importance of direct social environment for information dissemination, which is typical for the population in the research area.

I heard that the head of my hamlet builds a BGP. So I decided to visit him to see the installation. He gave me good information about the system and explained to me how to install it. Then I decided to do it by my own and I invested 450,000 VND.

I had recognized that my animal husbandry influences my neighbors. That’s why I decided to install the BGP to use the waste from animals. Now I have fuel to use,

reduced the environmental pollution, my neighbors are happy and in the future I will have sludge to apply to my planted trees. (QN 216)

**Box 5-5 : Verbal Statements – The case of Mr. Nguyen Thanh Long, 37**

However, regarding the attitude and behavior of this respondent, this case probably represents the exception that proves the rule.

In addition to these results, the expert-interviews revealed information about the governmental Extension Service on local level. The Extension Service is the principal institution for the transmission of information from the governmental level to the local population and owns further the function of development assistance.

**The Rural Extension Service<sup>30</sup> in Relation to the System's Innovations**

In the three villages the Extension Service is organized by one extension officer per hamlet. The officers participate in meetings of the local PC and try to inform and encourage the inhabitants in reunions and by personal visits. That means each officer is responsible to transmit information on a broad range of topics to approximately 300 to 700 families. In some cases they are even in charge of the technical assistance for construction of BGP and ML as well as other issues. In 1997 the Vietnamese Government (GoV) agreed on the measure to remove the traditional fishpond-latrines. No explicit regulations to build BGP or ML have been passed. But people were encouraged to stop dwellings, animal houses and latrines above public water bodies. In the period of 1997 till 2000 the local government spread information about BGP and three types of latrines by leaflet and TV. Since then no further activity has been realized. The proposed latrines' construction by bamboo shelter and with a hole in the ground (simple pit-latrines) was not sophisticated enough. Many problems occurred and therefore the acceptance was low and/or has an additional negative impact for further innovations in this scope. These facts represent great lack of institutional structure and efficiency referring to its internal organization, quantity of personnel and its professionalism. One key factor therefore is the very low budget of the Extension Service as it is stated in the recent Mekong Delta poverty assessment (UNDP A. AUSAID 2003: 45f).

It is necessary to establish well trained extension officers and reliable contact persons for technical assistance. The analysis on information access for BGP-use has shown that the direct social environment plays a major role. Therefore, demonstration units in each hamlet should be built up together with farmers who receive esteem by their fellow citizens and hence function as disseminators of the innovation. This might be a promising approach to achieve the groups of "Early Adopters" and "Early Majority".

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<sup>30</sup> Expert-Interviews: People's Committee of the three Villages 22-23/12/2003 realized by the author together with translator.



### 5.8.2.2 Financing the BGP

As already mentioned, the variety of BGP models is high due to the innovative creativity to reduce costs by producing plagiarism. *Figure 5-46* explains in detail the financing aspects, which came upon in the research sites separated according to the two principal models PE-BGP and CC-BGP. First of all it indicates that the great majority is financed by credits, especially referring to PE-BGP. A couple of BGP were for free. This fact is based on the background that the CTU initially installed some BGPs as research and demonstration units. Regarding the relatively higher amount of cash paid CC-BGPs it can be supposed that these installations are of bigger size in OFHs with large livestock, which dispose of enough capital to invest.

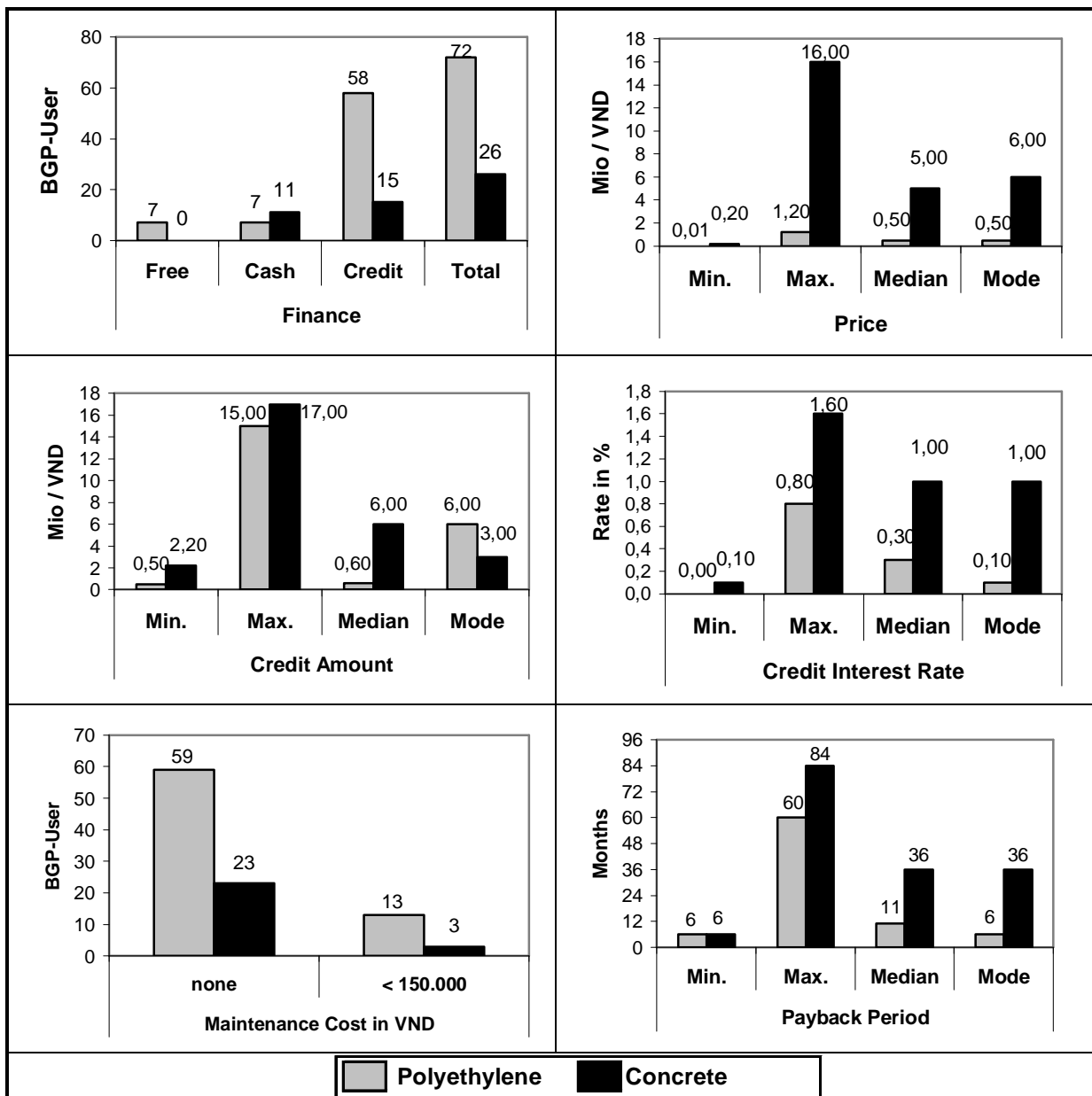


Figure 5-46 : Financing of Biogas Plants (n=98)

The analysis of prices shows that the PE-BGP costs about 500,000 VND and the CC-BGP ten times as much. The great variation of credit sums relies on the fact that

in many cases the credit is not exclusively for the installation but also to supplement livestock. Regarding the credit interest rate, the results prove the information of the key-person interviews (*cp. Chapter 5.3.4*). The very low interest rates can be explained by those households that were involved in an international cooperation project that offered these more accessible rates. Furthermore, the OFHs mentioned none or low maintenance costs, although in the case of PE-BGP almost 20 % required some kind of reparation up to 150,000 VND. Considering the amortization of a PE-BGP the following exemplary calculation can be made. According to OFHs' information a tank (12.5 kg) of liquefied petroleum gas (LPG) costs on average 100,000 VND and suffices 1.5 month for cooking in a five-person-household. Consequently, 1 year would be enough to refinance the PE-BGP including possible expenses for maintenance and installing. But fact is that the great majority cannot afford cooking solely on basis of LPG. It was found out that some better off households use LPG in addition to firewood if necessary and because of comfort. This calculation does not work out for households using firewood as until today there is no scarcity of firewood. Due to the fact that for the principal use of cooking both BGP models are appropriate in their efficiency, the payback rate of the CC-BGP is three to six times higher which meets the price relation.

Unless specific individual reasons are predominant the economic advantage of the PE-BGP is obvious. Later in the manifestation of attitudes towards the different models there are direct reasons for and against each BGP-type. According to this information a selection of statements is presented in *Box 5-6* to emphasize the situation and problems from the socio-economic point of view.

- ↪ I don't have a certificate of my land, so I cannot borrow money. QN15
- ↪ I planned to borrow money for BGP but the PC did not agree because I am poor. QN82
- ↪ The interest is too high, 1% per month. QN103
- ↪ I am afraid I cannot give the money back. QN120
- ↪ When I borrow money I have to pay interest. May be then I have to offend my people. QN204
- ↪ The output for sugar-cane is very low and unstable; we have to change our production! QN202
- ↪ The price for pig feed such as broken rice and rice bran is too high, we can not afford it anymore. QN204

**Box 5-6 : Verbal Statements – BGP-Finance**

The statements indicate three important aspects, which hamper the acceptance to use BGP; unfavorable conditions of credit allocation, the economic and image issue to pay the money back and the insecure market situation especially related to pig production.

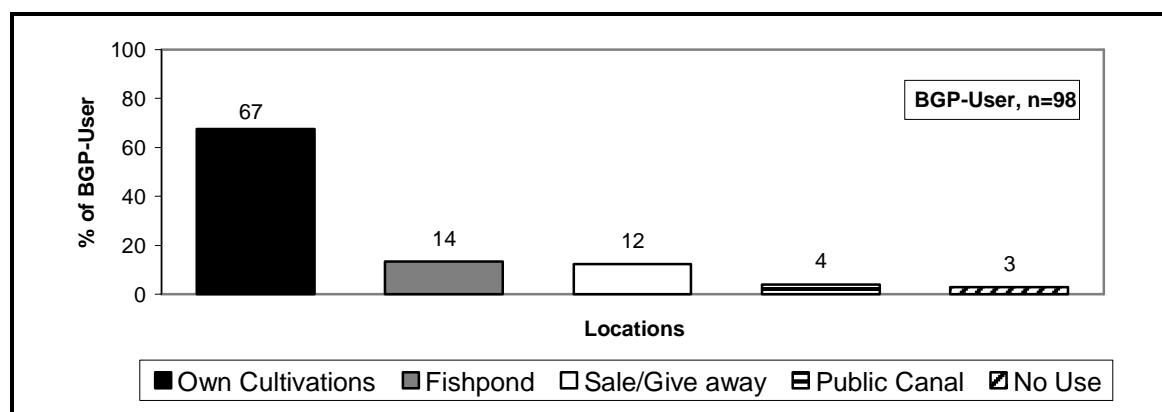
### 5.8.2.3 BGP-Management

Principally the BGPs are run by animal feces and here predominate pig dung. In general it is calculated that 1 kg of pig manure is required for 1 meter of PE-BGP, or 1 adult pig for 4 meter PE-BGP. Consequently, 4-6 fattening pigs or 2 sows plus shoats give enough input for the biogas production for cooking in 4-6 person household. Using pig manure, the produced gas becomes inflammable after 2-4 weeks after beginning BGP operation and is usable for cooking after 30-42 days (VO, WATANABE ET AL. 2002: 275ff). Of the 98 BGP-Users only 21 have a connected modern latrine (ML) and hence, do use human feces too. This group of the 21 System-Users will be analyzed later on in more detail as this group can be seen as "Pioneers" concerning the acceptance of the whole system for an optimization of wastewater management in the operating farm household.

Concerning the question of emptying the BGP, the PE-type shows a great advantage as long as the input is pig dung or human feces. In comparison to cow dung the material structure is very fine, not dissolving but floating in the sense that it does not sediment like cow dung. Hence, in the case of PE-tubes the major emptying management is done by a steady flow with the effluent. It can take years until it would be necessary to empty the BGP and thus in most of the cases the PE-type is thrown away completely due to its lower durability. Nevertheless, the steady flow entails a lower efficiency in biogas production as well as in hygieneization of the wastewater.

In case of CC-type the emptying procedure requires a higher workload as it has to be scooped out with a bucket. According to the users' response no common, regular practice regarding the emptying time schedule can be identified. On the one hand it depends on the intensity of use and secondly it varies among the users to empty the tank from being half to totally full. Even the BGP-Users' decision to empty it completely or to leave a starter is almost 50 to 50 %. This depends on the BGP-model as well as on the custom to replace the old PE-BGP by a new one as well as surrounding conditions.

The received information for what reason the farmers empty the BGP is illustrated in the following *Figure 5-47*.



**Figure 5-47 : Location of Deposition of BGS after Emptying BGP**

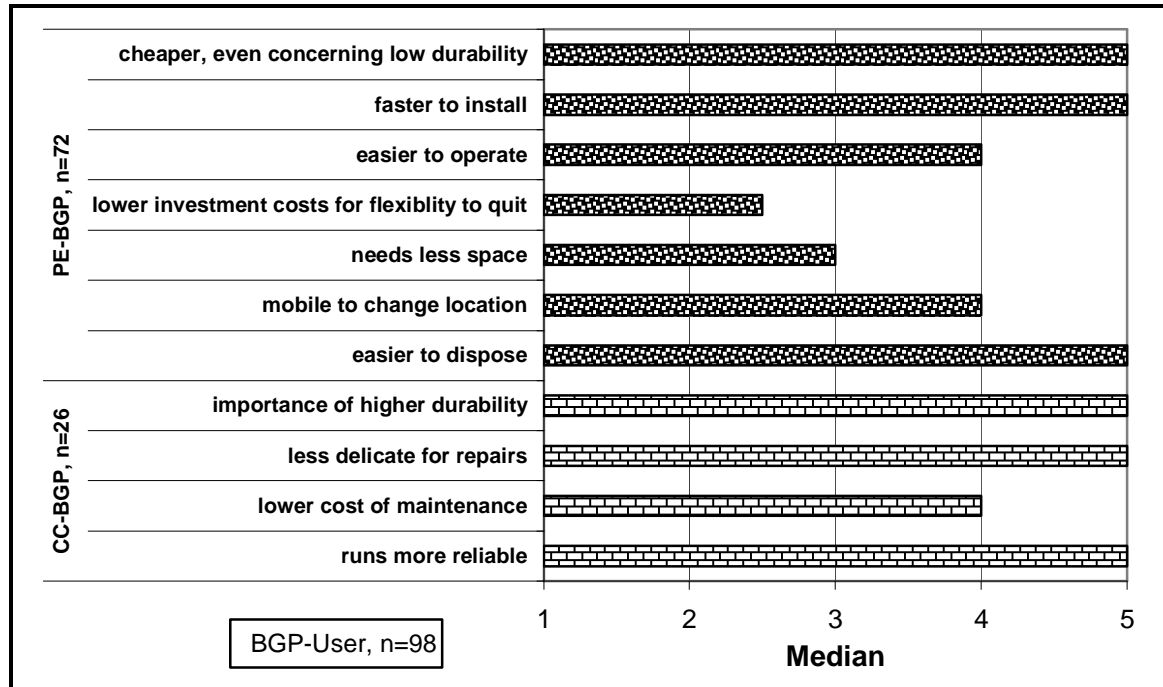
About two thirds use the BGS for own cultivation as fertilizer and thereof 10 % mention to mix it first with ashes or even mineral fertilizer. The emptying to the fishpond is quite unusual as in the case of PE-BGP the continuous effluent is used for aquaculture. Thus, it matches almost with not to use it but to get rid of it in the easiest way. Although it is only 12 % of the OFHs which sale or gives it away to persons of the close social environment, it indicates to have a value for some OFHs. The aspect of BGS use will be evaluated in more detail in the chapter analyzing the acceptance to use organic material and BGS in particular.

### 5.8.3 Reasons for Investment and Use

In this chapter the most important reasons for investment and use of BGPs in view of BGP-Users as well as BGP-Non-Users will be presented.

#### Valuation of BGP-Models

In the first step the BGP-Users' assessment of the different BGP-models is analyzed. *Figure 5-48* is split into the group of PE-BGP users and CC-BGP users. The latter do not account much more than a third of the other user group. Referring to this information it is essential to point out again, that no more OFHs with BGP could be found in the three research sites. Thus, it shows a clear preference for the PE-BGP model by the OFHs and/or the promoting and distributing institutions.



**Figure 5-48 : BGP-Users' Assessment according to the BGP-Models**

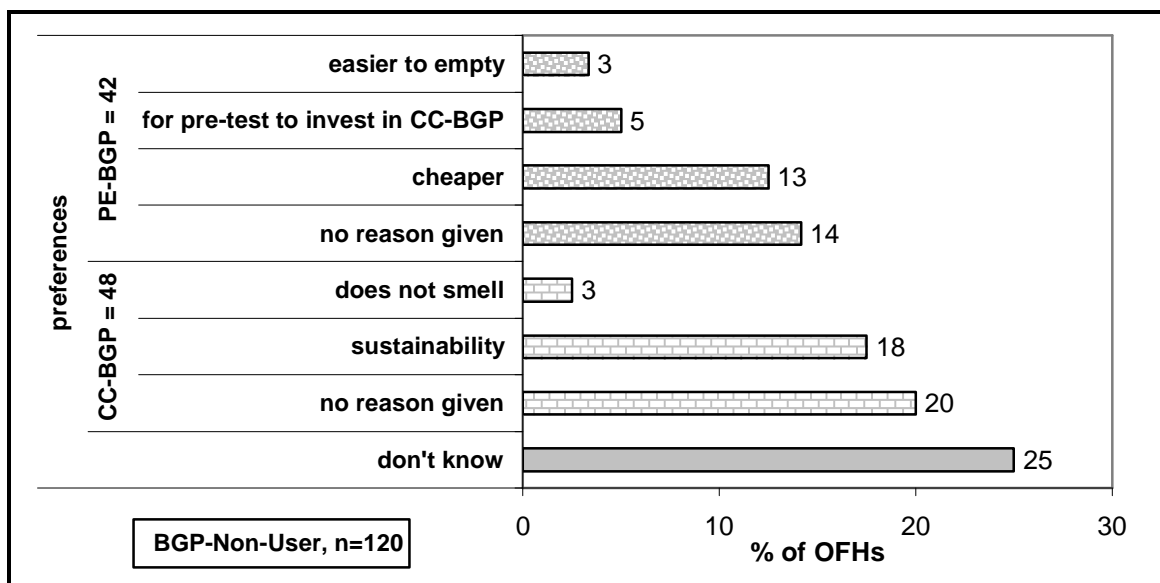
Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, (4) rather true, (5) absolutely true

The respondents were asked to appraise the listed comments and were allowed to add aspects if they feel to do so. The results, regarding the PE-BGP, show high importance of low costs, time and workload for installation and disposal. The ease to

operate and mobility are also high valued aspects. Contrary, the requirement of space does not seem to be a decisive factor and surprisingly the flexibility to quit the use of BGP due to lower investment costs is perceived as less true.

In the case of the CC-BGP-Users highest value is given to quality, durability and thus a reliable utilization of the BGP. The lower maintenance costs due to these characteristics are highly valued as well.

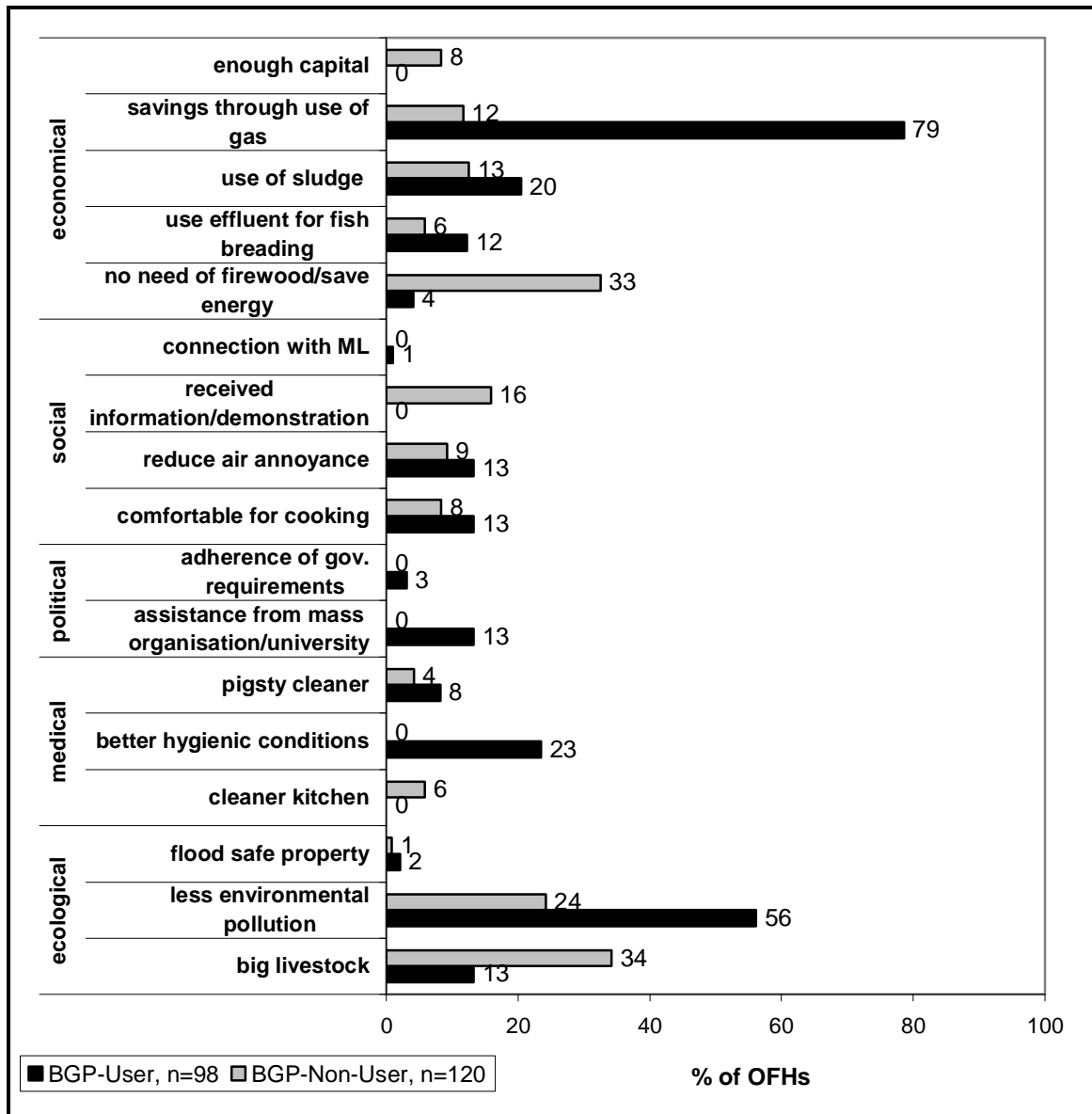
In the following *Figure 5-49* the results are demonstrated on the openly formulated question for which BGP model the Non-User-OFHs would decide and for what reason. In the case of the 120 Non-Users the general preference for the CC-BGP-Model wins 48 to 42 responding OFHs. One quarter stated that they do not know. Over one third each voted for PE-BGP and CC-BGP respectively. Concerning the PE-BGP proponents the low cost and therefore possibility to use it as test installation for the general attributes and the ease of use were decisive aspects. Regarding the CC-BGP supporters the core argument is the sustainability of the installation which additionally might base on bad reputation concerning the PE-BGP quality and durability.



**Figure 5-49 : BGP-Non Users' Reasons According to BGP-Models**

The decision for or against the type of BGP depends on very individual preferences, due to the surrounding conditions such as space, production, family size and especially the available capital. Despite the slight majority of CC-BGP it can be assumed that the PE-BGP is the model for the broader range of OFHs due to the very low cost, the adaptability in size, its mobility and ease of use. The start capital is much lower and accordingly the risk of investment. Although the costs are low and therefore it is particularly interesting for poorer families it still requires some kind of support or a suitable credit system.

In the following paragraphs, motives and constraints for investment and use of BGP in general as well as its acceptability are going to be evaluated. *Figure 5-50* shows the results of the survey for the most important aspects for investment and use of a BGP from two points of view; the appraisal of the BGP-users (average of 2.6 votings) themselves and the estimation of the BGP-Non-Users (average of 1.7 votings) why the User-OFHs decided to invest in BGP. Further it was required to mention up to three reasons according to their priority, if possible.



**Figure 5-50 : Assessment on Most Important Reasons for Investment and Use of BGP by BGP-Users and BGP-Non-Users<sup>31</sup>** (Multiple choice answers possible)

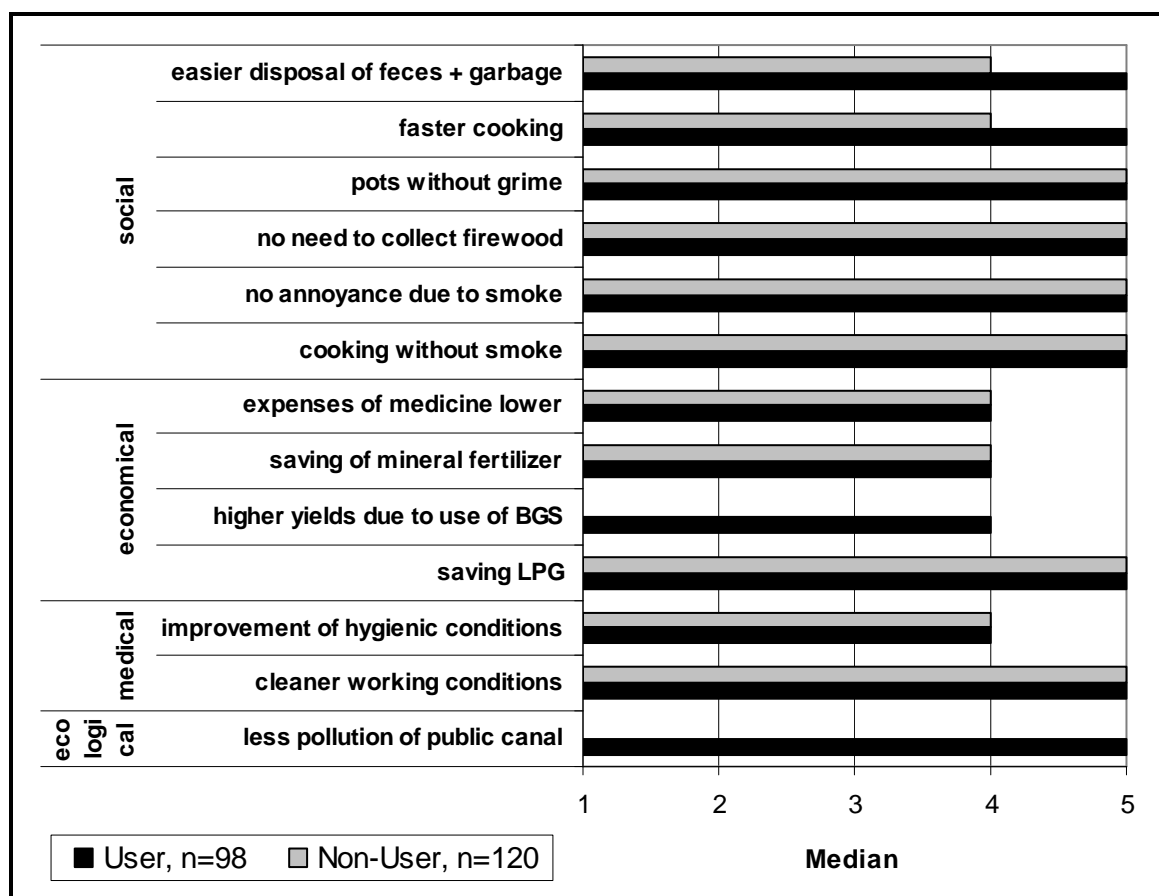
Among the priority of reasons as they were asked from first to third, in case of the User-OFHs avoidance of environmental pollution occupies first priority with 32 %

<sup>31</sup> Big livestock is categorized in the ecological dimension as many OFHs with big livestock are forced by the local authorities to use a BGP. But this aspect has to be recognized for the economical dimension as well, because it also resembles to have considerable capital.

before the use of biogas with 23 % and improvement of hygienic conditions with 10 %. But in second and third mentioned priority, the importance to save money by using biogas clearly gains over the other reasons and that finally leads to the added up core factors seen in the Figure. In case of the BGP-Non-Users' estimation, the order is big livestock property 32 %, replacement of firewood 13 % and better information about BGP attributes 11 %. Summing up the votes in the same way, *Figure 5-50* reveals only the third most important aspect changed to environmental protection. Big livestock property and firewood maintained to be the major factors for investment and use. The BGP-Non-Users express the necessity to receive in-depth information, the BGP-User require technical assistance. Furthermore, it has to be remarked that the BGP-Non-Users did not mention the aspects of improvement of hygienic conditions and the connection to ML in this openly formulated question. The User-OFHs hardly mention the aspect to link ML to BGP and they do not perceive the necessity to receive information and demonstration. Additionally, both OFH-groups valued the comfort issues rather high. The use of BGS is mentioned by one fifth of the BGP-User-OFHs and also the BGP-Non-Users estimate this aspect as one reason for acceptance to use BGP. Generally, these results are similar to those of the study of sanitation issues in North Viet Nam by MUKHERJEE (2001: 25). The difference is that here more emphasis is given to economical aspects like livestock, gas/firewood and the reason of environmental protection.

In further course of the survey, both OFH-groups received the task of valuing a selection of possible perceived advantages of using BGP as shown in *Figure 5-51*. The selection of aspects mainly bases on the experience of the studies by ADCOM (2002: 8ff) and MUKHERJEE (2001: 13ff). All aspects were appraised as rather or absolutely true by both OFH-groups. Reviewing the results in detail (arithmetic average and mode) did not show more differentiated results and thus, no subgroup (> 10 % choosing category 1 or 2) could be detected. Instead, all aspects with the category five (absolutely true) are based on more than 85 % of the OFHs' appraisal of category four or five. Lower appraisal was given to the hygienic improvement and reduction of pharmaceutical expenses, the saving of mineral fertilizer and impact of BGS. This supports the assumptions made already, that for higher BGS value the OFHs require on-hand information about its impact. Likewise the ability to liaise reduction of medicine expenses through the improvement of hygienic conditions is low and needs emphasis on health education and hygienic practices as defined in the NRWSS to improve the OFHs' attitudes (MARD A. MOC 2000: 11ff).

In case of the Non-Users comfort issues like cooking time and waste disposal were also slightly less valued. Probably the enhancement of practical demonstrations by confidants of the direct social environment might improve the situation.



**Figure 5-51 : Users' and Non-Users' Assessment of Advantages by Using BGP**

Two aspects were only assessed by the User-OFHs as it was supposed that assessments of these aspects were impossible for Non-User-OFHs.

Median on a scale from 1 to 5: **(1)** absolutely not true, **(2)** rather not true, **(3)** partly true, partly not true, **(4)** rather true, **(5)** absolutely true

In conclusion of the analysis, reasons and motives for investment and use of BGP, it can be recorded that the perceived advantages are not concentrated on one single dimension, but rather manifold. Both BGP-models obviously have their perceived pro and contra due to the average economical situation of the OFHs, PE-BGP is more likely to be accepted, although the Non-User-OFHs show a slight preference for CC-BGP. Concerning the expressed motives, the statements of *Box 5-7* give a further impression of the OFHs' thinking about the investment and use of BGP.

- ↪ We want to have biogas and toilet to save money from buying wood and fuel every month. QN140
- ↪ We have too many pigs, so we had to install BGP and ML to prevent smell and pollution. QN99/107
- ↪ Framers build BGP because they are afraid to offend neighbor with pig waste/smell. QN208

**Box 5-7 : Verbal Statements – Pro BGP-Investment**



Hence, for the BGP-Users the predominant factors are the use of biogas to save money, the contribution to environmental protection, which might be forced politically, or the direct social environment and also the improvement of hygienic conditions play a major role. By comparison, the BGP-Non-Users principally perceive that a big livestock property enforces the investment and use of BGP; they define the replacement of firewood by gas as a pushing factor and further believe that the BGP-Users received better information about BGP attributes. Last but not least, BGP-Non-Users mentioned the contribution to environmental protection as an important determinant for acceptance.

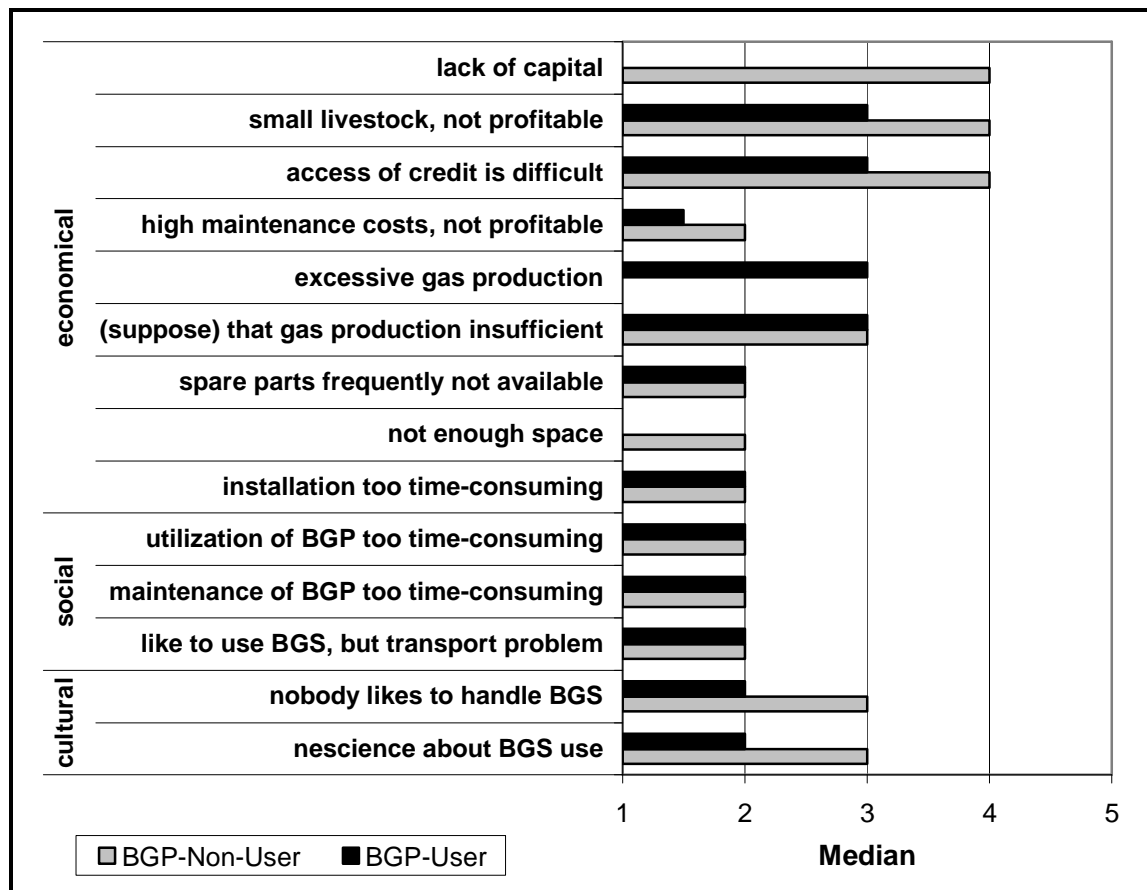
#### **5.8.4 Constraints for Investment and Use**

The research team at the College of Agriculture of CTU found out in its study that the principal constraints for ownership of BGP are the high construction costs and farmers' lack of training (ICLARM 1996: 24f).

This chapter gets into a detailed analysis of constraints. In the assessment of constraints for investment and use of BGP, all aspects found in the broad literature review were evaluated (e.g. GUTTERER 1997; FEDER 1984; BUI, PRESTON ET AL. 1997). Furthermore, the respondents were asked for additional aspects in case that they perceive it as incomplete. Accordingly, *Figure 5-52* illustrates the respondents' valuation of a statement collection regarding possible constraints.

The general value tendency is similar for both OFH-groups. The aspects with highest priority are on the one hand economic issues as cash or credit availability and lack of livestock. Regarding gas production both extremes seem to be perceived. The BGP-Users value the excess as well as the insufficiency at same grade and the BGP-Non-users assume that the gas production will not be enough to substitute the firewood necessity completely. In addition, especially the BGP-Non-Users show doubts concerning the BGS use. The remaining aspects are confirmed to have a rather low importance for the investment and use of BGP.

Minor livestock may be an economic constraint but probably has to be understood also as social factor in the sense lack of information. Farmers do not have information about the variety of possibilities to run the BGP. They assume that a BGP can be run solely with piggery and not on the basis of another kind of animal production or even the opportunity to connect their sanitary infrastructure. Thus, most important is a detailed clarification of facts and subject related education, so that the farmers are able to choose from a consolidated knowledge background. Furthermore, this calls for the offer of a real custom-to-fit system, for example by means of a small turntable to calculate requirements and opportunities by themselves. Additionally, demonstration units which do not only focus the positive way but also inform the worst case scenario and possible solutions are necessary for a sustainable introduction of this new technology.



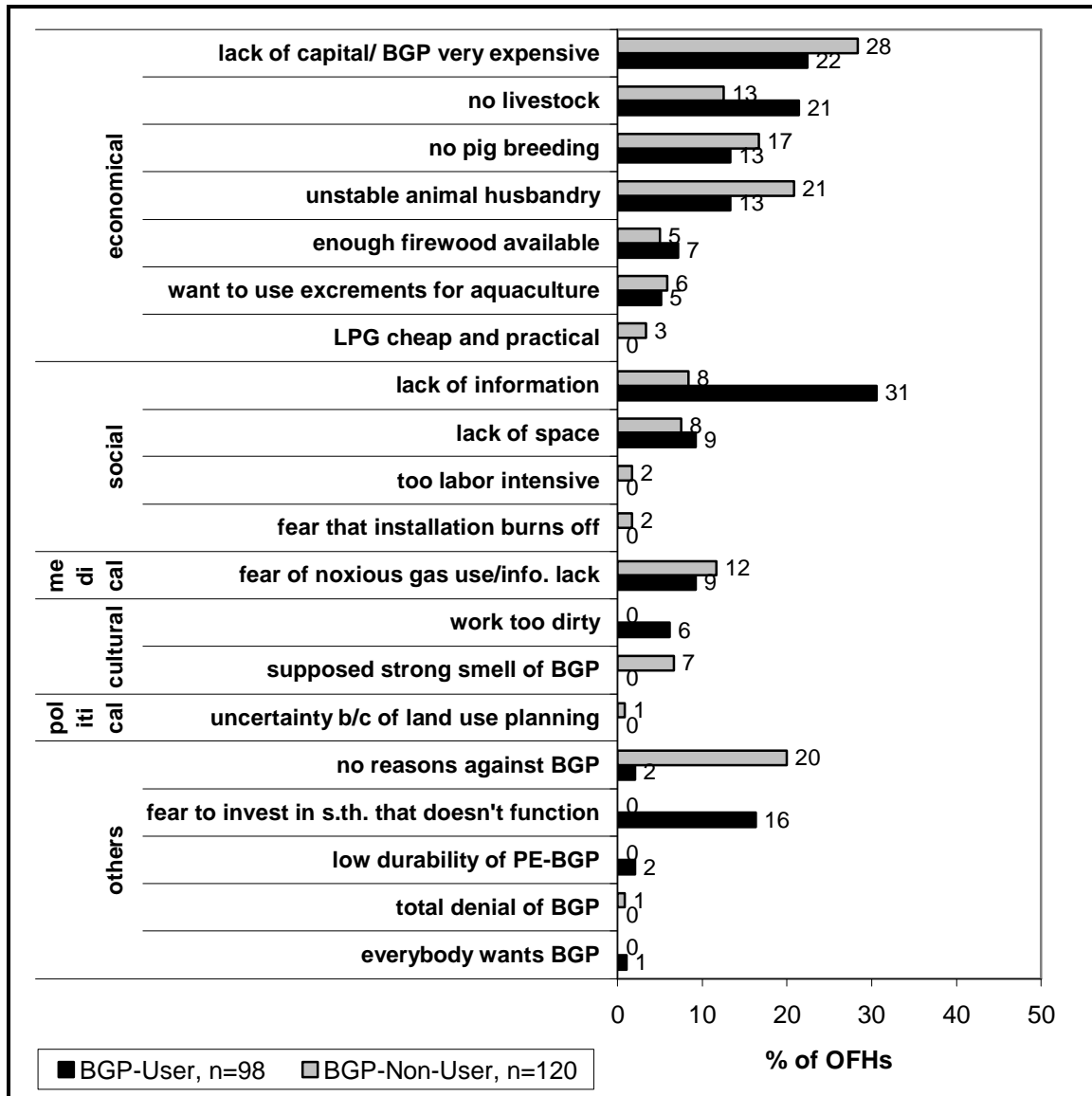
**Figure 5-52 : BGP-Non-Users' and –Users' Assessment of Aspects Against Investment and Use of BGP**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Once again, the results tend to be unilateral. On the one hand this proves that the assumed aspects were well selected. On the other hand, in this case a couple of small subgroups were found out by the detailed distribution review. With regard to the BGP-Non-Users, small subgroups (10 to 20 %) with the opposite opinion (category 1 and 2) were found among the aspects of profitability, spare parts availability, time-consuming installation and transport problem of BGS. They support the assumption that the information strategy needs to be improved quantitatively and qualitatively in order to achieve a progress of the diffusion process making the step to the “Early and Late Majority” of OFHs.

In the following evaluation presented in *Figure 5-53* the most important reasons that hamper or even avoid the use of BGP are analyzed. Consequently it is the reasoning by BGP-Non-Users (average of 1.5 votings) and the estimation of factors by BGP-Users (average of 1.8 votings) why the other OFH-group does not invest in and use BGP. In case of the Non-Users within the priority of reasons as they were asked from first to third, no specific reasons against BGP use took the first place with 20 %, the lack of capital with 18 % before the aspect not to have pig breeding with 14 %. Adding up the votes the economic factors including the problems of capital and livestock insufficiency clearly dominate.

Nevertheless, the positive sign not to see any specific reason keeps high priority. Further determinants worth mentioning are the lack of information including the fear that biogas use might be noxious as well as other doubts that are based on knowledge deficiency. By comparison, the User-OFHs estimated by 21 % that lack of capital might be the reason, secondly with 20 % small or missing of livestock and in third priority with 11 % that the OFHs have no piggery.



**Figure 5-53 : Assessment on Principal Constraints for Investment and Use of BGP by BGP-Non-Users and BGP-Users** (Multiple choice answers possible)

Added up in the same way, the priority on economic reasons remains in general but the two factors of information lack including specific issues or prejudices that gas use is noxious and smells badly and the work dirty as well as fear of investing in something that after all does not function. Due to the presented results a selection of original statements is listed according the principal issues of market instability,

technical assistance, lack of information and prejudices as well as quality standard in material as well as trained people for construction of BGP in *Box 5-8*.

### **Market Instability and Livestock**

- ↪ The price of pig is low, so they don't want to raise pig and thus don't want to install BGP. QN104
- ↪ We had to stop the BGP for 3-4 months, because we had to stop piggery due to low prices, but now we started again. QN176
- ↪ Now raising pigs is not favorable, thus I would like to be supported in this aspect so that raising pigs is continuous and profitable. So I can use BGP and BGS. QN12

### **Training and Assistance**

- ↪ My BGP is not working from the beginning and I am waiting since 7 months for the technician. QN95
- ↪ I produce more gas than I can use and I can not store it, so it leaks out and causes bad smell. QN126
- ↪ I built the ML before the BGP, so I can not connect them; even I have enough feces from piggery. QN28/160

### **Lack of Information and Prejudices**

- ↪ People are anxious that BGP burns there house. QN110
- ↪ I doubt whether the BGP damages health or not. QN215

### **Quality Standard**

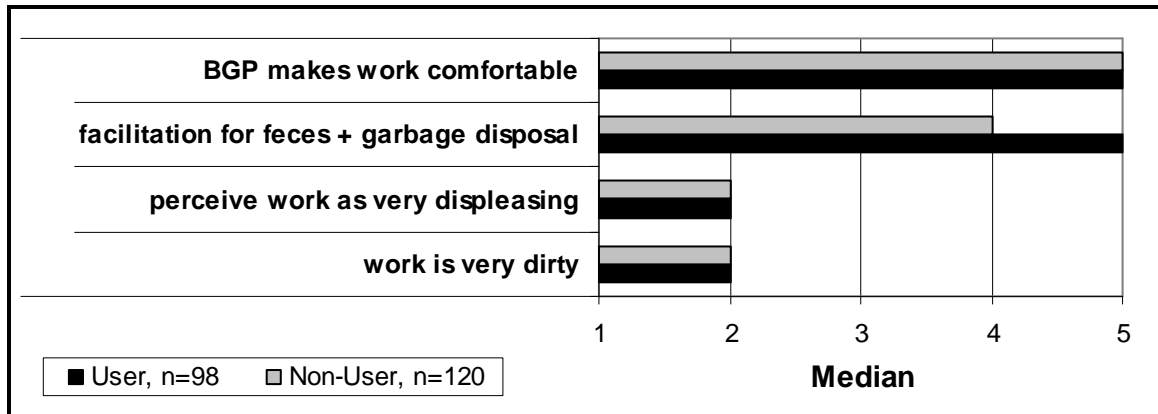
- ↪ The plastic BGP breaks easily! Many people failed when using these! QN120/110/109

#### **Box 5-8 : Verbal Statements – Contra BGP-Investment**

Although there are some differences in the priority and quantity of votes between the estimation of reasons mentioned by the User-OFHs and the proper reasons explained by the Non-User-OFHs, these statements underline the findings of core determinants that hamper the acceptance behavior.

#### **5.8.5 Acceptability**

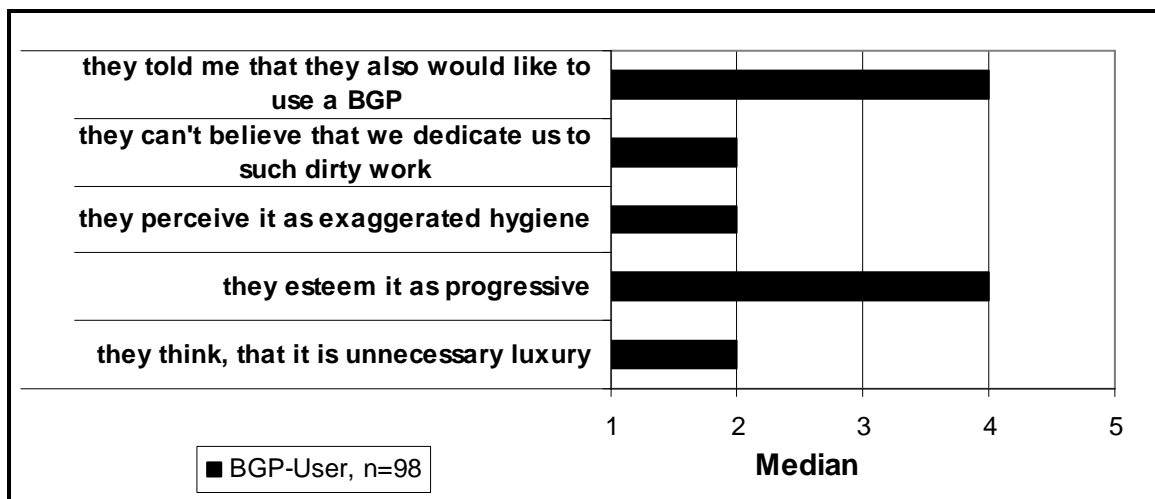
In the last chapter some aspects concerning the acceptability were manifested already as the question on constraints or reasons against the use of BGP can include socio-cultural aspects related to handling aversion and prestige. Consequently, the OFHs were asked to value the perceived working conditions while using BGP. Referring to the displayed results in *Figure 5-54* the respondents of both groups have very positive experiences or in case of the Non-Users have a very positive attitude towards this type of work. Even more, they perceive the BGP as a practical manner to dispose feces and garbage.



**Figure 5-54 : Working Conditions concerning the Use of BGP**  
 Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Hence, concerning the handling there does not seem to be important constraints. Although in the later Chapter on BGS especially the handling of the same is evaluated in-depth and has to be taken into account.

In this context it is important to also get information about the esteem of using a BGP in the community, as the BGP-Users perceive it.

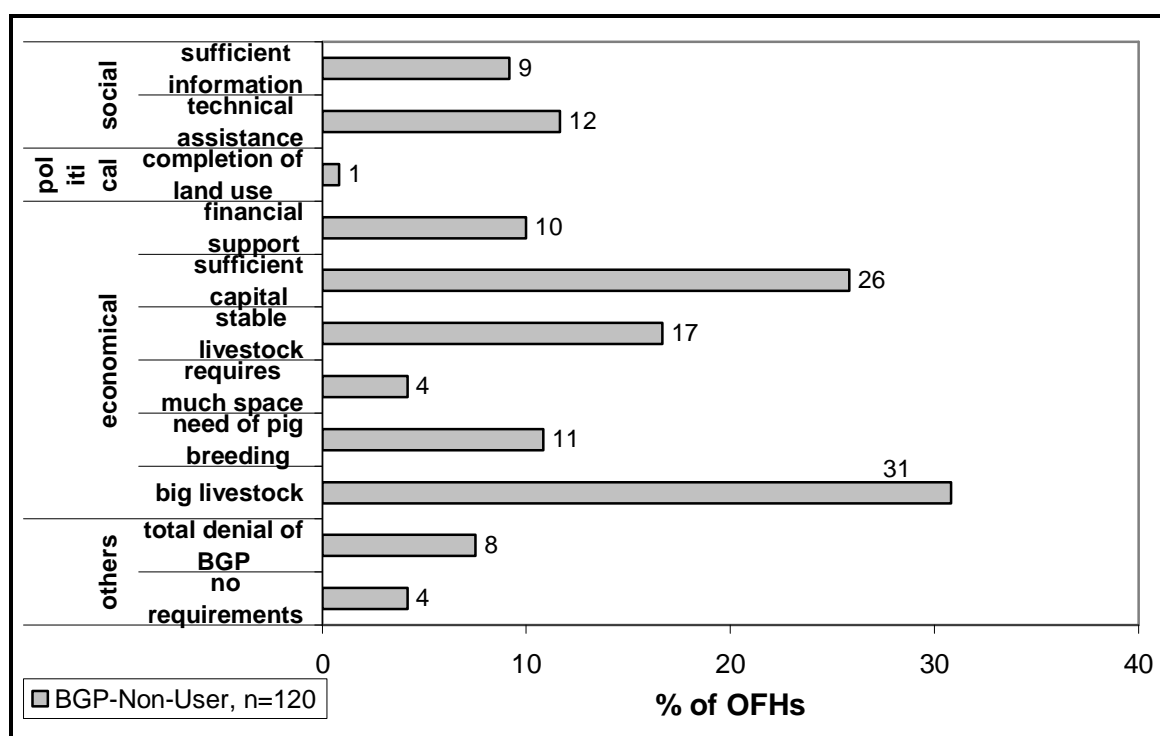


**Figure 5-55 : BGP-Users' Estimation of BGP-Non-Users' Attitudes Towards Investment and Use of BGPs**  
 Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Accordingly, the BGP-Users valuation what they think how the persons of their direct social environment esteem the BGP use is presented in *Figure 5-55*. Once again, the response is very positively estimated. BGP use seems to have a very progressive image and is perceived as a desirable installation to own.

One view point is the esteem of certain advantages by using the innovation; the other one is the question on requirements or necessities for investment and acceptance to use BGP. Consequently, the Non-Users had the opportunity to mention and explain what they perceive as necessary conditions or requirements to use BGP (average of 1.3 votings). The results displayed in *Figure 5-56* indicate a clear message.

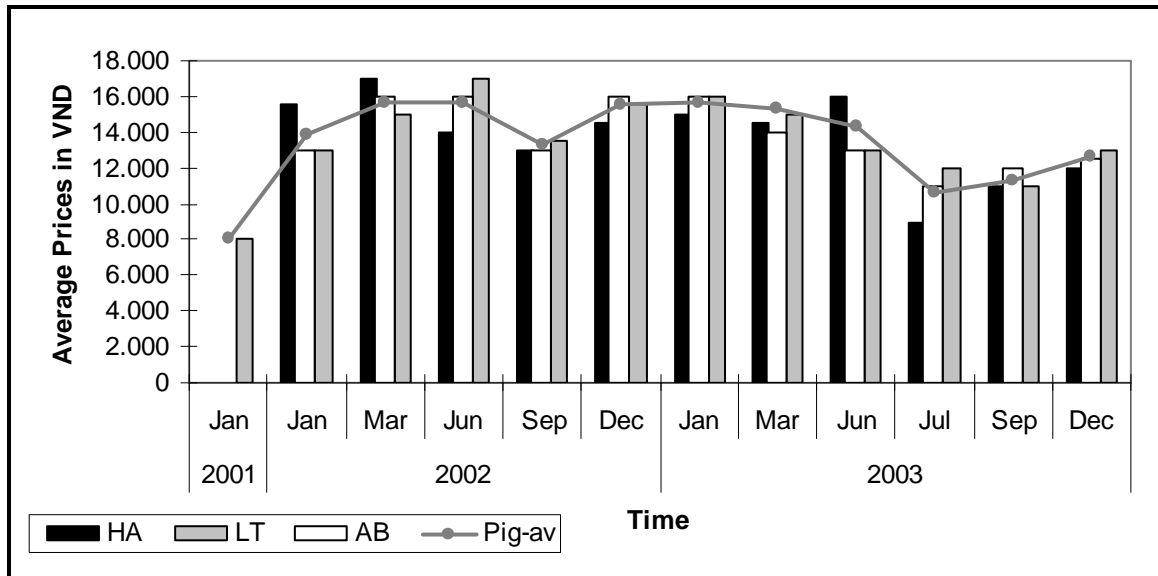
Emphasis lies on economic issues such as capital in cash and/or livestock as well as a more reliable and calculable market situation for animal husbandry which means especially means piggery. This indicates that piggery is seen as basic necessity to invest in BGP and that the required capital is a core constrain. Further, even for the OFHs with enough capital or possibility to raise a credit, the market price fluctuations implicate an incalculable risk, which hampers or inhibits the disposition for investment. Although the Non-User-OFHs stated with very high percentage that they received information and demonstrations referring to the use of BGP (*cp. Figure 5-45*), they demonstrate a rather high importance to improve the sufficiency of information and technical assistance.



**Figure 5-56 : Non-Users' perceived Requirements / Necessary Conditions for Investment in BGP**

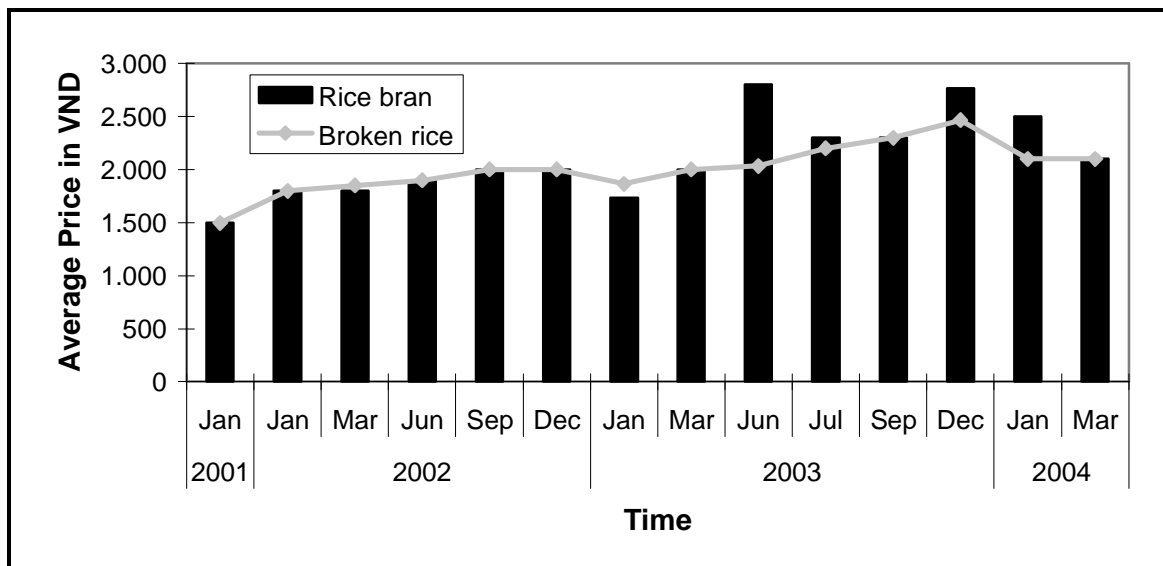
According to the fact that especially the economic reasons of piggery are perceived and explained as principal constrains, key-person interviews<sup>32</sup> were conducted to get more information about the fluctuation of market prices regarding piggery. *Figure 5-57* reveals the collected information about market prices of pigs. Although, the indication of market prices could only be achieved in a relatively short period, it can be clearly seen, that the prices go down around September as the majority of OFHs sell pigs in this time of the year.

<sup>32</sup> Expert-Interviews: People's Committee (veterinary, representative of farmer union) of the three Villages 22-23/12/2003 realized by the author together with translator.



**Figure 5-57 : Market Prices of Pigs in the Three Research Sites**

It can be assumed that the principal reason is the lack of income because of the rainy season as well as the necessity to invest in seeds and other production means for the next cultivation period. January is also a main selling time for pigs due to the demand for Chinese New Year celebration. But prices keep higher as the demand is so high that the production can hardly satisfy it. On top of that *Figure 5-58* illustrates the price development of the commonly used pig fodder (rice bran and broken rice) during the same period of time.



**Figure 5-58 : Market Prices of Pig Fodder**

The antipodal price fluctuation as well as a general tendency of rising fodder prices is visible. The decisive factor for the periodic price variation is the retarded adoption possibilities of production according the changed price expectancies (Cobweb-Theorem). Of course it is difficult to control the market price for agricultural products, especially for piggery. But communication and professional education may help to

rationalize the expectancies so that the OFHs more realistically anticipate the long-term value without falling into the trap of short-term price increase (HENRICHSMEYER A. WITZKE 1991: 323ff). Subsequently, the recommendation to improve the installations, the OFHs were asked for suggestions and perceived demands for investment and use of BGP. A selection of the most common statements is demonstrated in *Box 5-9*.

### **Finance and Policies**

- ↪ Government has to offer credit with long duration, for example 3 years. Then we can pay it back. QN208
- ↪ The government should have policy to support and stabilize the market prices, so that farmers have a steady production and income. QN180
- ↪ Biogas brings profit to family and society, so we need policies to encourage those who have piggery to invest in the system. QN91

### **Information**

- ↪ We should have a broadcasting station in each hamlet. QN217
- ↪ I suggest building a demonstration place about BGP, so that people can consider the benefit of biogas use. QN15/198

### **Assistance**

- ↪ I have enough capital, but I need better information and a reliable technical assistance to build the system. QN159/187
- ↪ I want to install reliable biogas system but I am afraid that other people do not have enough skills to make it. So if I get the guidance and design of researchers from the University, I will install it. QN138
- ↪ The government should supply basic information and professional training for the farmers. QN27/22

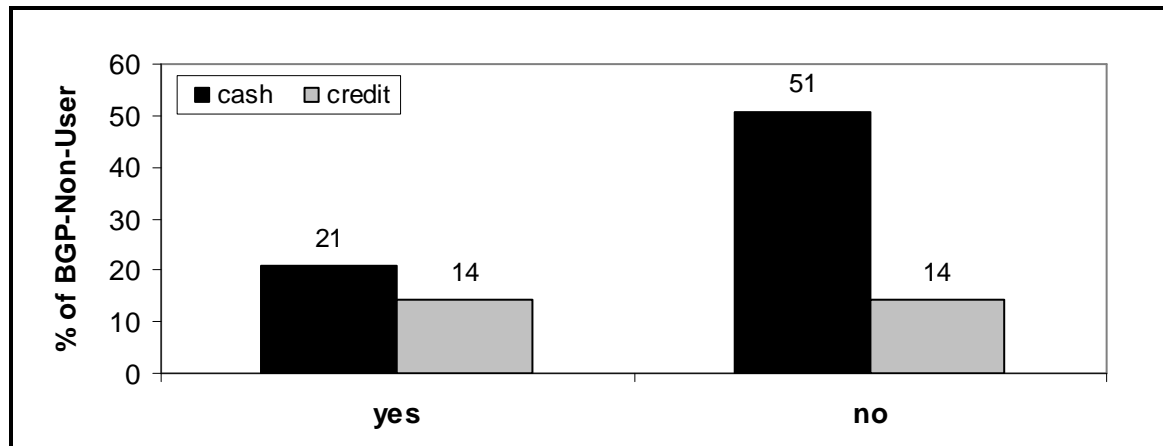
### **Box 5-9 : Verbal Statements – Suggestions / Demands for BGP- Investment and Use**

Consistent with the analyzed results before, the statements can be categorized in the issues of “Finance and Policies” as well as “Information” and “Assistance”. The fact that these are the core groups already indicates the importance of tasks and functions of the Extension Service and the necessity of a network of microfinance institutions as the existing opportunities, quality and extend is insufficient for a progressive rural development with emphasis on water management issues.

Last but not least, at the end of this section of the questionnaire the Non-User-OFHs were asked to decide whether they are going to invest in a BGP within the following 12 months and how they would prefer to do so. The result is that two-thirds do not have the intention to invest in BGP. But in case they would do, 70 % prefer to invest in cash. In the case of the third of OFHs that aims to invest in BGP, only 14 % would prefer to raise a credit for this purpose. The tendency is for cash investment but as



soon as it gets closer to action the OFHs economic situation requires an investment by credit.



**Figure 5-59 : BGP-Non-Users' Tendency for Proximate Investment in a BGP**

On the question to the User-OFHs, what they would recommend to improve the BGP almost 90 % could not give any suggestion. The remaining OFHs concentrated on the improvement of construction quality as the durability of the tube, reliability of connections and valves. But they also mentioned that the emptying procedure has to be improved. Further, they wished to have a system built by meter-segments so that they would have the opportunity to adapt the size of the BGP to the fluctuation of livestock size (fluctuation of available input). This gives evidence for the need of more flexibility referring to the construction as well as finance of the system without losing reliability.

#### **5.8.6 Summary of the Findings and Conclusions for Acceptance of BGP**

The major results of the BGP acceptance analysis is resumed in the scene of the Non-Users' and Users' point of view. According to the chapter, basic information about the BGP-models and information, finance and management issues is summarized. Recapitulating the results, the OFHs are convinced of its positive, progressive image. About 20 % of the BGP-Non-Users stated to have no specific reason against BGP-use. But restraining factors for investment and sustainable utilization do exist. Consequently, the evaluation of constraints and according requirements for investment and use of BGP elucidates several aspects.

Likewise, the perceived and estimated advantages by BGP-Users and BGP-Non-Users are not concentrated on one single dimension, but rather manifold and thus, prove the necessity of a holistic survey approach.

#### **Principal Aspects of Present BGP-Use**

The original model of PE-BGP costs 800,000 VND with the recommended concrete base and coverage up to 1.5 million VND. None of these have been observed in the

surveyed villages. Instead, the PE-BGPs are built with emphasis on cost reduction, in many cases featuring lack of quality, which leaves bad reputation due to problems in functionality, reliability and durability. In several cases PE-BGP is perceived as “beginners’ model” to test with low cost the BGP impacts. Both BGP-models obviously have their perceived pro and contra and due to the average economical situation of the OFHs, PE-BGP is more likely to be accepted (distribution: 72 PE-BGP against 26 CC-BGP), although the Non-User-OFHs show a slight preference for CC-BGP. This seems to be based on the higher durability (probably due to the unreliability through PE-BGP plagiarism) and disregarding the investment costs. However, low costs as well as low time and workload for installation and BGS disposal (emptying) are principal determinants of the BGP-model valuation.

The direct social environment plays the core role as first contact, informant or demonstrator for BGP-use, although mass media, governmental and international institutions are mentioned as well. Rural Extension Service works out to some degree and technical assistance for BGP is available even limited and insufficient. Thus the relation of officers and OFHs is weak, private contacts/factions seem to be favored.

BGPs are mainly invested by credit relying on initiatives from CTU and international organizations (PE-BGP approx. 500,000 VND, CC-BGP 5 million VND). Credit interests vary from median 0.3 to 1.0 % per month depending on repayment time (median of 6 and 36 months) and creditor. In case of BGP with the bank as creditor, only credits of production are allocated with a maximum time schedule of 12 months. A special credit program for BGP is not available.

With regard to the management of BGP 4-6 fattening pigs or 2 sows plus shoats give sufficient input to run a 10 m<sup>3</sup> BGP. The emptying procedure in case of PE-BGP is low frequented due to the steady flow of effluent as long as it is run by pig dung (fine, floating material structure). In case of CC-BGP emptying is perceived difficult and uncomfortable. Consequently, BGS is dried in a hole and sometimes mixed with ashes and/or mineral fertilizer before application. Over two-thirds of BGP-Users use BGS for own cultivations and aquaculture, others try to sell it or don’t use it at all. In this context the assumption emerges that information about a BGS impact and value calculation is not available for the OFHs. Further analysis of this aspect provides *Chapter 5.10.3* concerning the constraints for investment and use of BGS.

### **Determinants of BGP Acceptance for Investment and Use**

In conclusion of the analysis about advantages/motives, constraints and requirements for investment and use of BGP, the resumed determinants presented in *Table 5-3* are listed according to the assessed importance for the OFHs’ acceptance behavior.

BGP-Non-User	BGP-User
<b>Major Perceived Advantages / Motives</b>	
<ol style="list-style-type: none"> <li>1. Big livestock property (obligation)</li> <li>2. Replacement of firewood</li> <li>3. Contribution to environmental protection</li> <li>4. Received sound information / demonstration</li> <li>5. Comfort for cooking</li> <li>6. Reduction of air annoyance (neighbors)</li> </ol>	<ol style="list-style-type: none"> <li>1. Use of biogas to save money</li> <li>2. Contribution to environmental protection</li> <li>3. Improvement of hygienic conditions</li> <li>4. Use of BGS</li> <li>5. Comfort for cooking</li> <li>6. Reduction of air annoyance (neighbors)</li> </ol>
<b>Major Perceived Constraints</b>	
<ol style="list-style-type: none"> <li>1. Lack of capital (cash or credit access)</li> <li>2. Unstable animal husbandry</li> <li>3. No / insufficient livestock / piggery</li> <li>4. Lack of information and technical assistance / existing prejudices</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of information / technical assistance</li> <li>2. Lack of capital (cash or credit access)</li> <li>3. No / insufficient / unstable livestock / piggery</li> <li>4. Fear of BGP's unreliability in function and quality (misinvestment)</li> </ol>
<b>Major Perceived Requirements</b>	
<ol style="list-style-type: none"> <li>1. Sufficient / large livestock (piggery)</li> <li>2. Sufficient capital / customized microfinance system</li> <li>3. Stability in animal husbandry</li> <li>4. Technical assistance</li> <li>5. Sound information about BGP</li> </ol>	<ol style="list-style-type: none"> <li>1. Customized microfinance system</li> <li>2. Improvement of PE-BGP quality</li> <li>3. Improvement of flexibility in BGP installation varieties</li> <li>4. No flood proneness</li> </ol>

**Table 5-3 : Determinants of BGP Acceptance**

The listed determinants of BGP-Non-Users' attitudes and BGP-Users' acceptance behavior in most cases are congruent, similar or at least complement one another. Within the following paragraphs, conclusions and first recommendations are summarized.

### **Finance and Credit**

Most of the BGPs are financed by credits, as the economic situation of many OFHs does not allow cash investment; especially if the investment size is higher due to the additional necessity of livestock. But credits in its majority (but small total number) are allocated by the CTU or in the scope of small development cooperation projects by international NGOs. It is not necessarily the inefficient poverty outreach but the appropriateness of credit or saving systems taking the OFHs' income amount and

time distribution into account. Consequently, the OFHs' acceptance of BGP can be increased through the establishment of a sustainable service network for microfinance at grassroots level.

### **Livestock and Market Instability**

Up to now BGP has been introduced on the basis of piggery. OFHs with big livestock property have been obliged to install a BGP in order to reduce environmental pollution, especially of surface water as well as to avoid air annoyances to neighbors. Others had smaller piggery operations and were given the opportunity to make use of the feces in order to have gas and more comfort for cooking, effluent for aquaculture and to facilitate the disposal of feces and garbage. And some households even started with piggery to take the advantages of BGP. But the problem is the unilateral dependency on continuous pig production with the additional constraint of significant fluctuations of their market (pig feed and pig meat).

In conclusion, the improvement of BGP acceptance and its further dissemination requires a diversification of input sources to run BGP (e.g. ML-connection). Additionally, the pig production needs to be stabilized in order to achieve a steadier price level and thus reduce the risk of misinvestment. Both aspects cannot be removed completely but can be improved through sound information transmission, professional education and technical assistance for the farmers.

### **Lack of Information and Prejudices**

The OFHs emphasize their lack of information with emphasis. This information deficit specifically refers to the BGP, its attributes, requirements to install, run and maintain as well as advantages (nescience about BGS use) and feasibility calculation. A considerable amount of BGP-Non-Users do not have information about the variety of possibilities to run the BGP such as to connect their sanitary infrastructure as additional input source. Furthermore, sound information is required to clear existing doubts and prejudices (use of BGP gas smells strong, is dirty and noxious; fear to burn off the installation).

The Agricultural Extension Service already tries to offer and transmit this information as well as the also directly mentioned necessity of technical assistance. But the institutional structure and efficiency referring on its internal organization, available quantity of field service personnel and its capacity are too weak.

Thus, capacity building through professional training, improvement of technical assistance including a custom-to-fit-system media (turntable for BGP investment calculation) as well as demonstration units and the establishment of a communication network for knowledge management might be solving measures.

### **Adaptability and Quality Standards**

The Vietnamese flexibility and creativity are very valuable characteristics. But the surpassing growing of the Vietnamese economy due to wild spread plagiarism, a culture of “spontaneous low cost adoption” to win the market, shows its negative impacts in all probability on the long run. Referring to acceptance and dissemination of BGP it has already led to unreliability and mistrust among the OFHs. The layers of the PE-BGP were reduced or different, less durable materials used to reduce the costs. Instead, the adaptation should be based on the unit size and its opportunity of successive extension as well as on an enhanced microfinance system to make the investment affordable. Further, standardized installation packages of CC- and PE-BGP, controlled by a monitoring unit (Extension Service) is important to assure a progressive process on the long-term. Additionally, the standardization and a supported wide spread introduction in mutual use would reduce the installation costs significantly.

### **BGP Acceptance in the Context of the OFH's Dimensions**

Implicating these findings for acceptance of BGP with the results of the OFHs' six dimensional environment, it can be concluded that the economic, social and ecological dimension comprehend the most important determinants. Indeed, the high value of environmental protection is questionable due to supposed social desirability. The OFHs aim to improve their rather low living standard by increasing income and comfort of their every-day life. The acceptance of BGP needs available (livestock-) capital/credit and its investment priority. This requires an economic calculation defining the time frame and possible profit. The importance of low risk investment is even higher in the case of credit and may be approached by a demand-oriented microfinance-system. The OFHs need to receive detailed and demonstrated information by reliable persons of their direct social environment. Thus, social issues (educational level, information access) have high importance for the innovations' diffusion process. The political dimension is important to set the legal and institutional framework for implementation. In case of OFHs with big livestock property it is a significant top-down approach for BGP-use which requires the social and economic factors for its sustainability. Considering the medical and ecological dimension, they have importance for the acceptance behavior due to their aspects (environmental protection prevents waterborne diseases and reduces health care expenses) that should be communicated and used to emphasize the necessity/advantage to use BGP. Due to low ethnic variety and the commonly used integrated farming systems in a river delta environment, the cultural dimension reveals no significant determinants for acceptance of BGP.

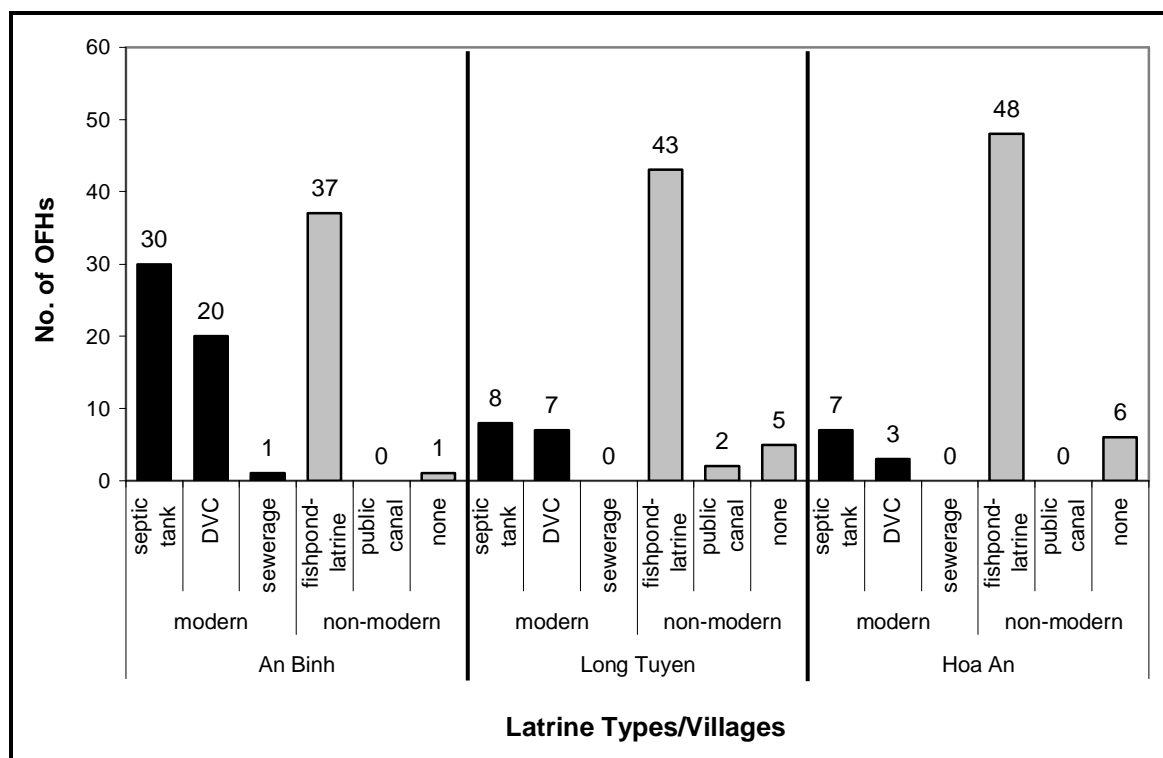
## 5.9 Modern Latrines – Perception of Attributes for Acceptance to Use

Objective of this Chapter is the detailed analysis of acceptance of investment and use of modern latrines (ML). Herein, it is not distinguished between different models of modern latrines. According to the existence of ML, the OFH-groups are structured into ML-User (n=76) and ML-Non-User (n=142). The situation of sanitary infrastructure on national level on the background of NRWSS has been described already in the *Chapter 3.2.3*.

After a short overview of the present sanitation conditions in the research sites, the analysis will focus on the principal aspects of information access, repressive and conducive factors for investment and use as well as requirements for a positive acceptance decision.

### 5.9.1 Basic Attributes and Conditions of ML in the Research Area

Among the surveyed households the total of 76 OFHs uses a modern latrine. Various types of ML have been found in the research villages. *Figure 5-60* demonstrates the distribution of latrine types, grouped in modern and non-modern according to the three villages. The expected dominance of traditional or no available latrine is clearly visible. Herein the majority of 128 OFHs uses the fishpond-latrine. Regarding the rural OFHs of Long Tuyen and Hoa An, less than 20 % of the OFHs has a ML and 10 % do not have any latrine at all. This distribution is congruent to the average of the Mekong Delta (GSO 2004).

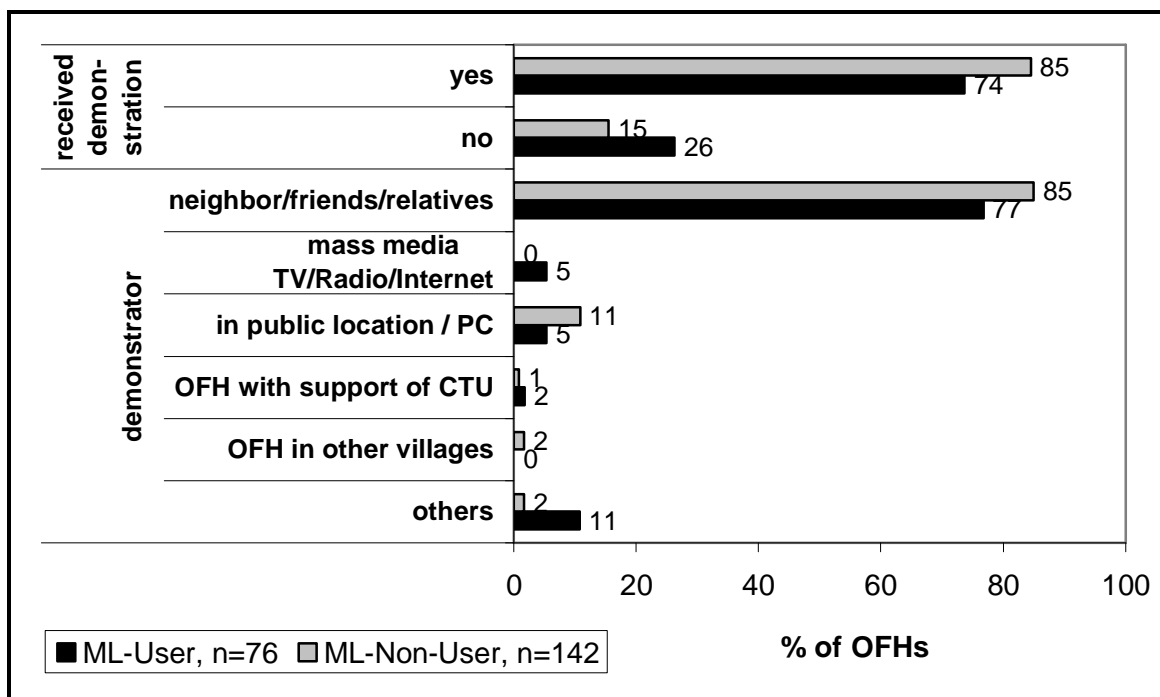


**Figure 5-60 : ML-User and ML-Non-User According to Latrine Type and Village (n=218)**

The higher amount of modern latrines in the village of An Binh bases on an UNICEF project in cooperation with the Health Center Can Tho conducted in 2002 including the construction of septic tank and DVC latrines. With reference to BGP-User and BGP-Non-User the distribution of modern latrines has a strong bias to the BGP-User-OFHs (from 13 to 36 %) in all villages in direction from rural to urban area.

### 5.9.1.1 Information Access

By analyzing attitudes and acceptance of BGP it was revealed in the previous chapters that information access is the key for further decision process of acceptance behavior. Consequently, this aspect is evaluated also concerning ML. In this more sensitive subject, the importance of direct social interaction is even higher than in the case of BGP-Users. *Figure 5-61* illustrates that the majority of respondents knows about ML on the basis of received demonstration. Furthermore, it is remarkable that the Non-User-OFHs seem to dispose of a better information status quo than the User-OFHs. But this might rely on social desirability to some degree.

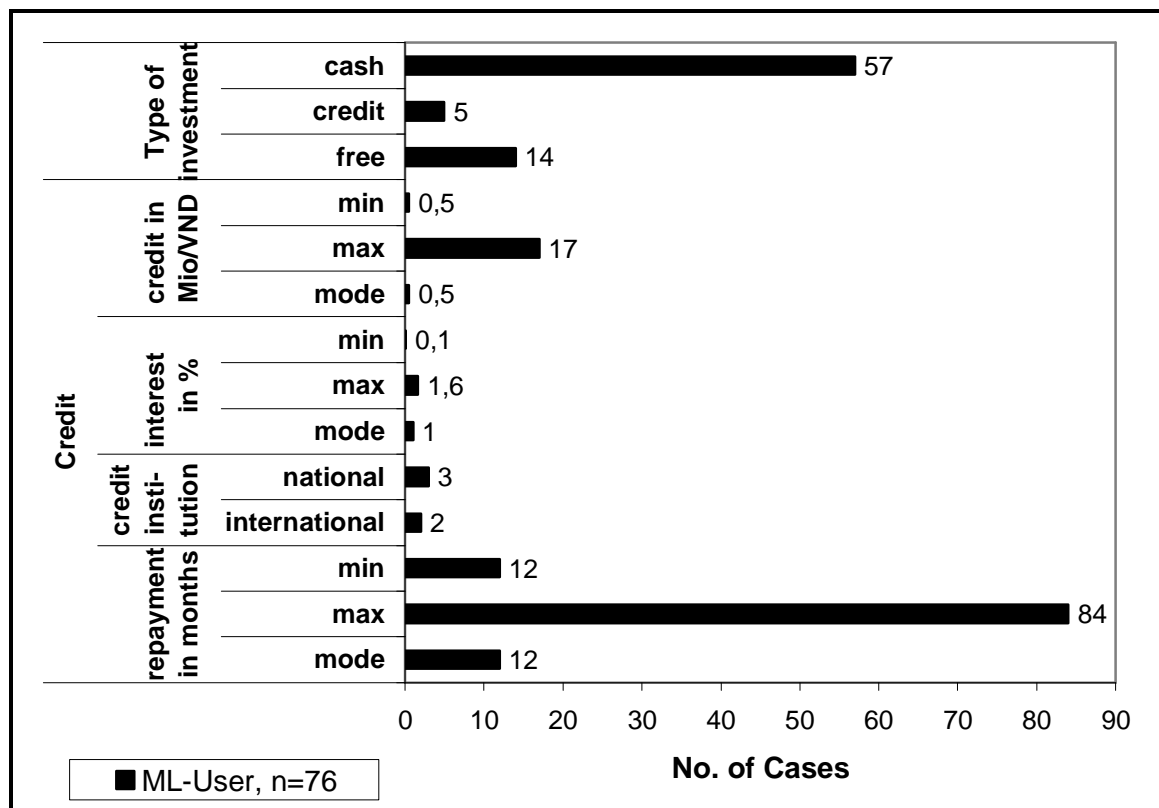


**Figure 5-61 : ML-Users' and ML-Non-Users' Social Interaction / Information Access for Use of ML**

### 5.9.1.2 Finance and Management of ML

Principally, the modern latrines are built as septic tank or DVC model. The costs of a ML can vary heavily due to the model and quality/luxury of construction. Hence, the costs may range from 450,000 to several million VND. *Figure 5-62* reveals the type of investment and the according credit conditions. The free latrines belong to the before mentioned UNICEF project (in some cases OFHs received ML for 300,000 VND; 200,000 VND as subsidy). Furthermore, it is clearly visible, that the cash investment

dominates. Due to the information of the respondents as it will be manifested in a later paragraph concerning reasons and requirements for investment, people have the opinion that a ML fits only to a new or at least modernized house. They stated being ashamed to build a ML which possibly has a higher value than the dwelling they live in. Thus, the credit amount varies from 0.5 to 17 million; the latter is a credit for a new house including the installation of a ML. Accordingly is the range of repayment time.



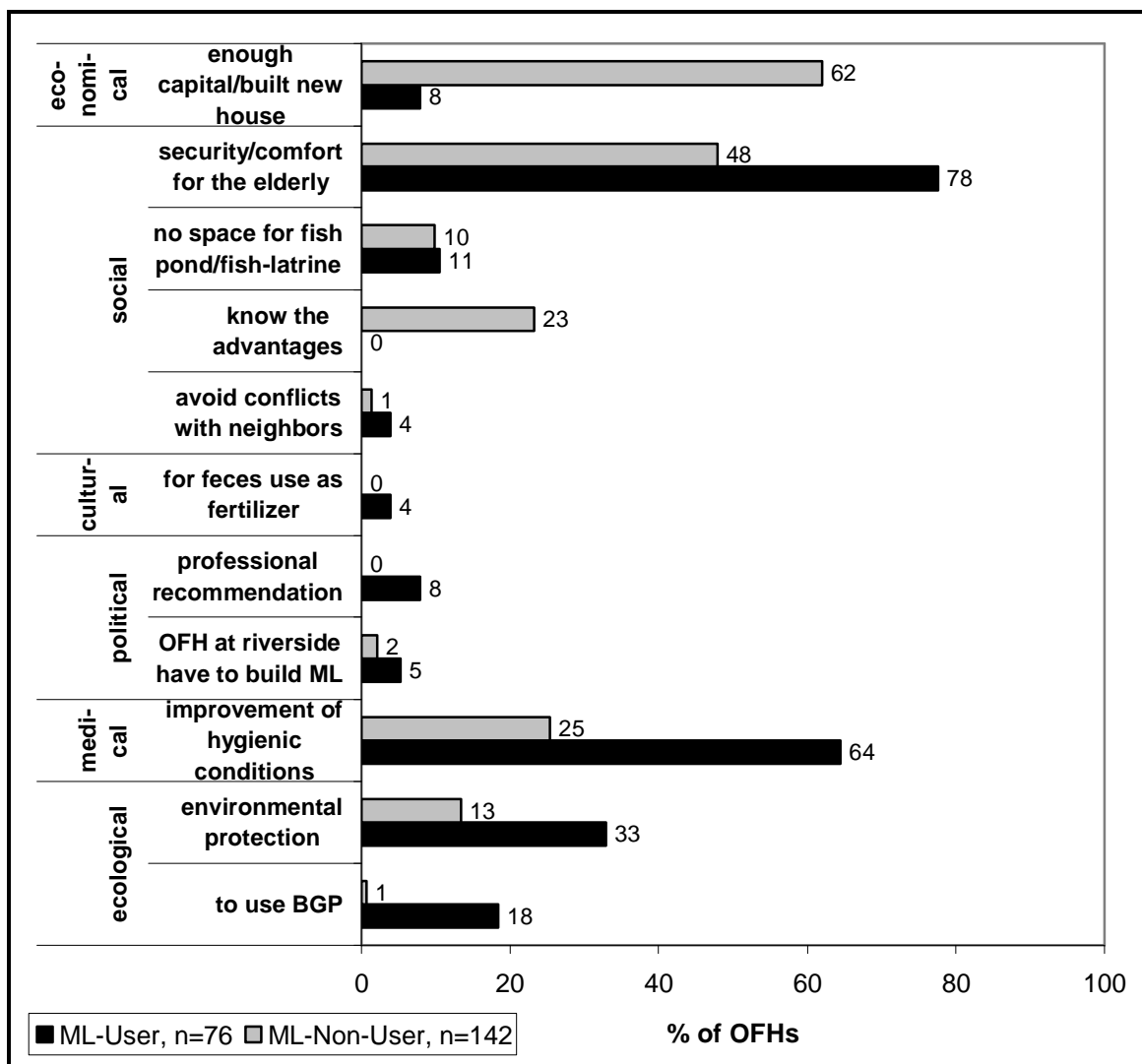
**Figure 5-62 : ML-Users' Financing of Modern Latrines**

Concerning the high frequency of cash investment, the same conclusion as for credits can be drawn. The OFHs, who could afford to build a new house or at least to renovate it, included the installation of a ML. People that live in a traditional or old house do not seem to have the initiative to invest in a ML by credit. Although ML credits are allocated within construction issues which allow a longer time of repayment (*cp. Chapter 5.3.4*) the OFHs do not seem to make use of it. Furthermore, the consolidated tradition of using fishpond-latrines relies on the agro-economic importance for aquaculture (*cp. Chapter 3.3.3*). Under cultural aspect, the use of a ML seems not to hold problems, but requires the opportunity of feces reuse (ADCOM 2002: 18f; MUKHERJEE 2001: 14). The connection to BGP can probably alleviate the strong bondage of BGP-utilization to piggery and furthermore, be a motive to invest in ML as the economical use of feces is diversified. Thus, reasons, constraints and requirements have to be evaluated in detail, to achieve statements based on fact and referring to the attitudes and acceptance behavior on investment and use of ML.



### 5.9.2 Reasons for Investment, Use and Connection on Biogas Plant

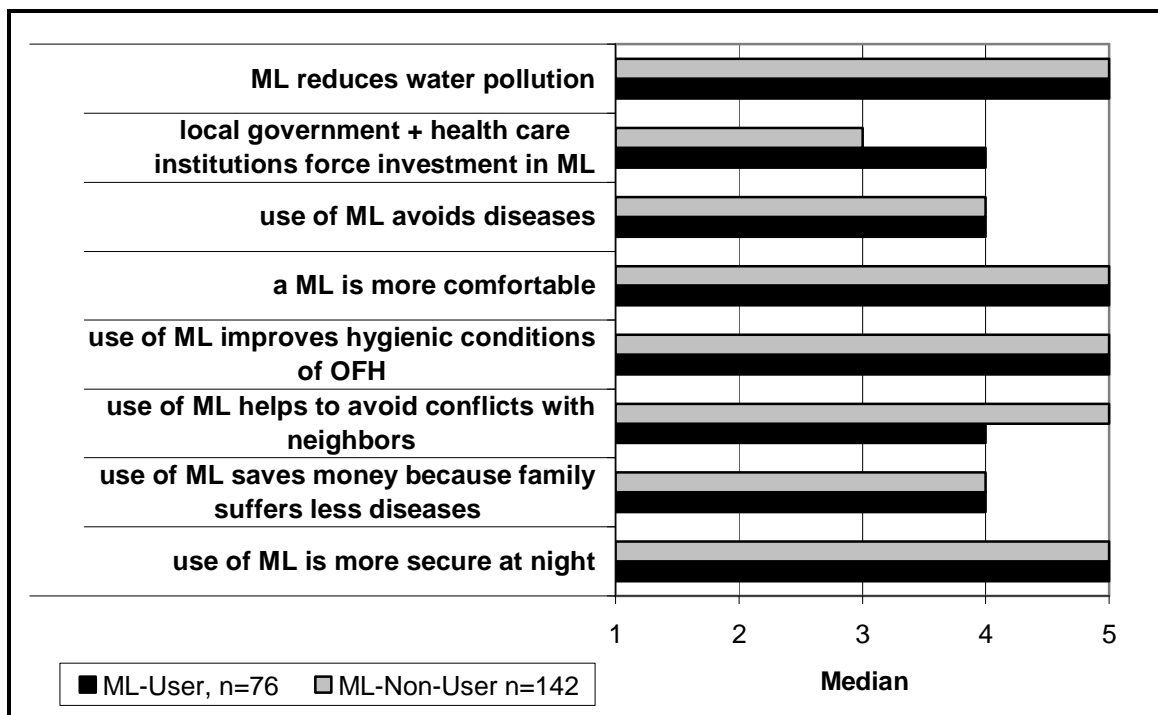
Likewise to the survey on BGP issues, in this case the ML-User were asked to state their principal three reasons for investment and use of ML and probably connection to BGP. The order of ML-Users' priorities (average of 1.9 votings) added up and demonstrated in *Figure 5-63* is the same in singular value. Security and comfort especially for children and elderly in the night as well as the improved hygienic conditions and environmental protection are the dominating motivations to invest in a ML. Furthermore, the use of BGP in connection to ML is at least on the fourth rank. From the ML-Non-Users' point of view (average of 2.3 votings) the ML-Users invested because they disposed of enough capital and/or built a new house.



**Figure 5-63 : Assessment of Most Important Reasons for Investment and Use of ML by ML-Users and ML-Non-Users (estimation)**  
(Multiple choice answers possible)

That makes clear that the required capital and the aspect of a new house are key factors for investment. Furthermore, high importance is given to information received about ML-use, which is the background for the statement that ML-Users know the

advantages of ML utilization. The following reasons are identical to the ones of ML-Users. The population density increases from rural to suburban area and thus, the necessity of ML; in some cases OFHs lack of space which means that they do not have enough land to operate a pond with the according fishpond-latrine. Sometimes the OFHs use one pond together (*cp. Appendix 3-2*). Even OFHs could be found that make use of this necessity of other OFHs and offer fishpond-latrines above their own pond in order to increase the aquaculture production by means of higher feces input. Accordingly, one OFH in An Binh was interviewed that installed sophisticated brick fishpond-latrines including electric illumination (*cp. Appendix 3-2*). Secondly, he put a sign at the canal pathway to refer to his offer. The respondent stated that he produces two crops of catfish per year with a total income of about 8 million VND. Additionally, he cleans the pond after each crop and uses the sludge to fertilize his fruit orchard. The ideas and initiatives to solve problems in an efficient way are manifold but nevertheless they prove the necessity of sanitation to improve hygienic and environmental conditions. Contrary to the openly formulated question, the OFHs were asked to assess given statements on motives for the investment and use of ML. The results illustrated in *Figure 5-64* affirm on the one hand the analyzed priorities which were commented freely and on the other hand they show that the political influence as well as the avoidance of conflicts with neighbors play a major role. All aspects assessed with the highest median value (five) are composed of 87 to 98 % of OFHs giving the values of the category four or five.

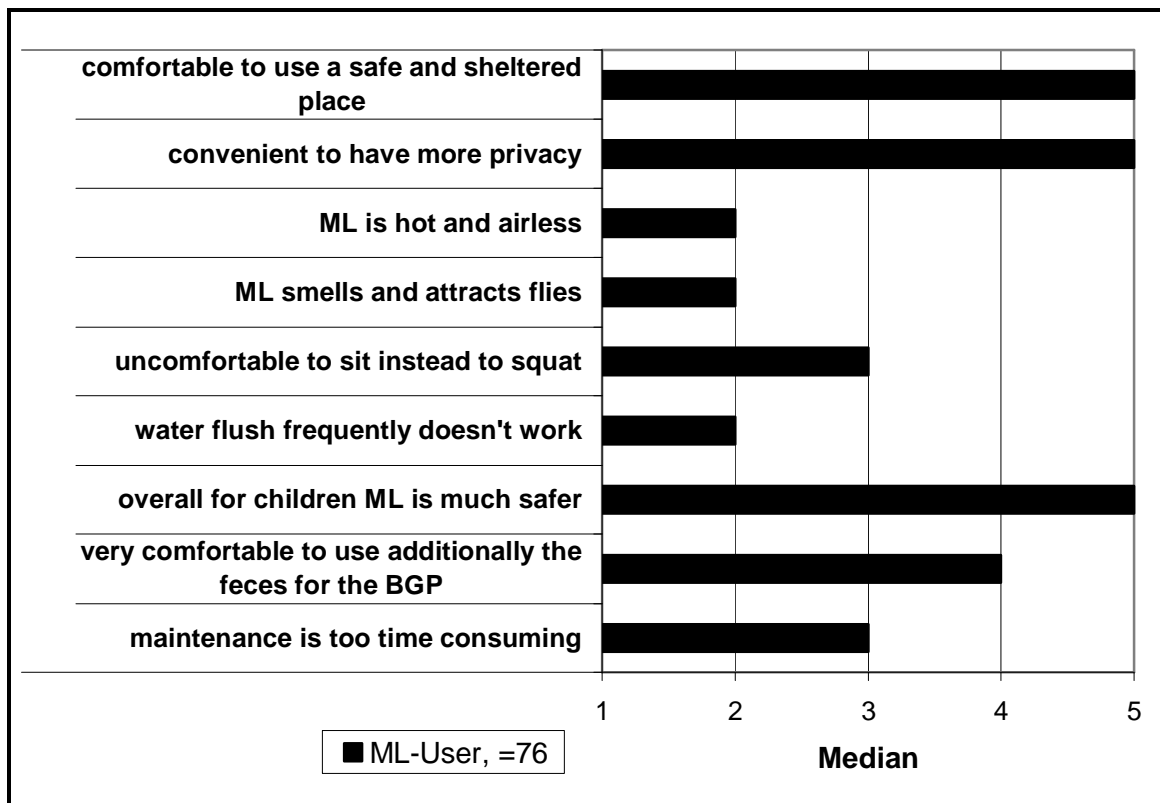


**Figure 5-64 : ML-Users' and ML-Non-Users' Assessment of Reasons for Investment and Use of ML**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, (4) rather true, (5) absolutely true

With regard to the results shown in *Figure 5-63* the ML-Non-Users' high importance for the issue of hygienic improvement is striking, but might explained by social desirability and the fact that in the openly formulated question, the ML-Non-Users were asked to estimate the ML-Users reasons for investment.

The economical issue to save money through fewer expenses for pharmaceuticals because of less disease occurrences is approved rather positively by both OFH-groups. In order to achieve more information on the perception of certain attributes while using ML, the ML-Users were asked to value mentioned attributes of ML utilization. Apart from the highly valued comfort and safety issues, privacy is very important aspect as *Figure 5-65* reveals. During the fieldwork, people occasionally were talking with great sense of humor about the traditional fishpond-latrine or as they called it "hello-toilet" because of the possibility to greet people passing by. Principally, they mentioned the advantage of excreta reuse for aquaculture. But they never mentioned the discomfort of lack of privacy which seems so obvious.

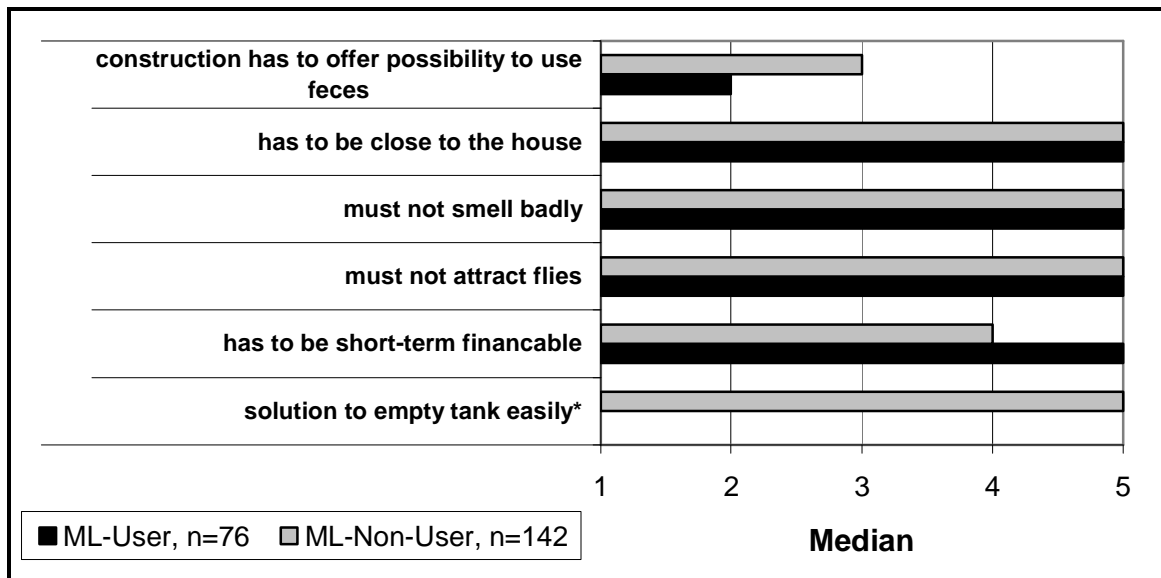


**Figure 5-65 : ML-Users' Assessment of ML Utilization Attributes**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, (4) rather true, (5) absolutely true

According to the respondents' assessment the construction does not have problems regarding lack of air, bad odor and accumulation of flies as the former pit latrines had. Furthermore, the opportunity to use the feces to run the BGP is very well appreciated. Squatting is partly preferred and thus should be kept in mind to offer different solutions of construction.

Last but not least, the households had the opportunity to assess a selection of constructional aspects shown in *Figure 5-66*. The location close to the house as well as the avoidance of bad odor and flies are perceived as essential. Concerning the issue to have the possibility to use the feces, the importance is surprisingly low. This fact states that the use of feces of a ML in the research site and possibly in the Mekong Delta is not absolutely necessary as in case of the fishpond-latrine for aquaculture or as other studies in central and northern Viet Nam reported to be a killing factor for sustainable acceptance of ML (ADCOM 2002: 18f). In the Mekong Delta, the aspect of feces reuse seems to be much more an economical based issue and less a traditional rooted behavior. The importance of a finance ability in short-term leads to the assumption that the OFHs prefer to invest cash in ML and thus, perceive ML as a luxurious good at the end of the chain of necessities.



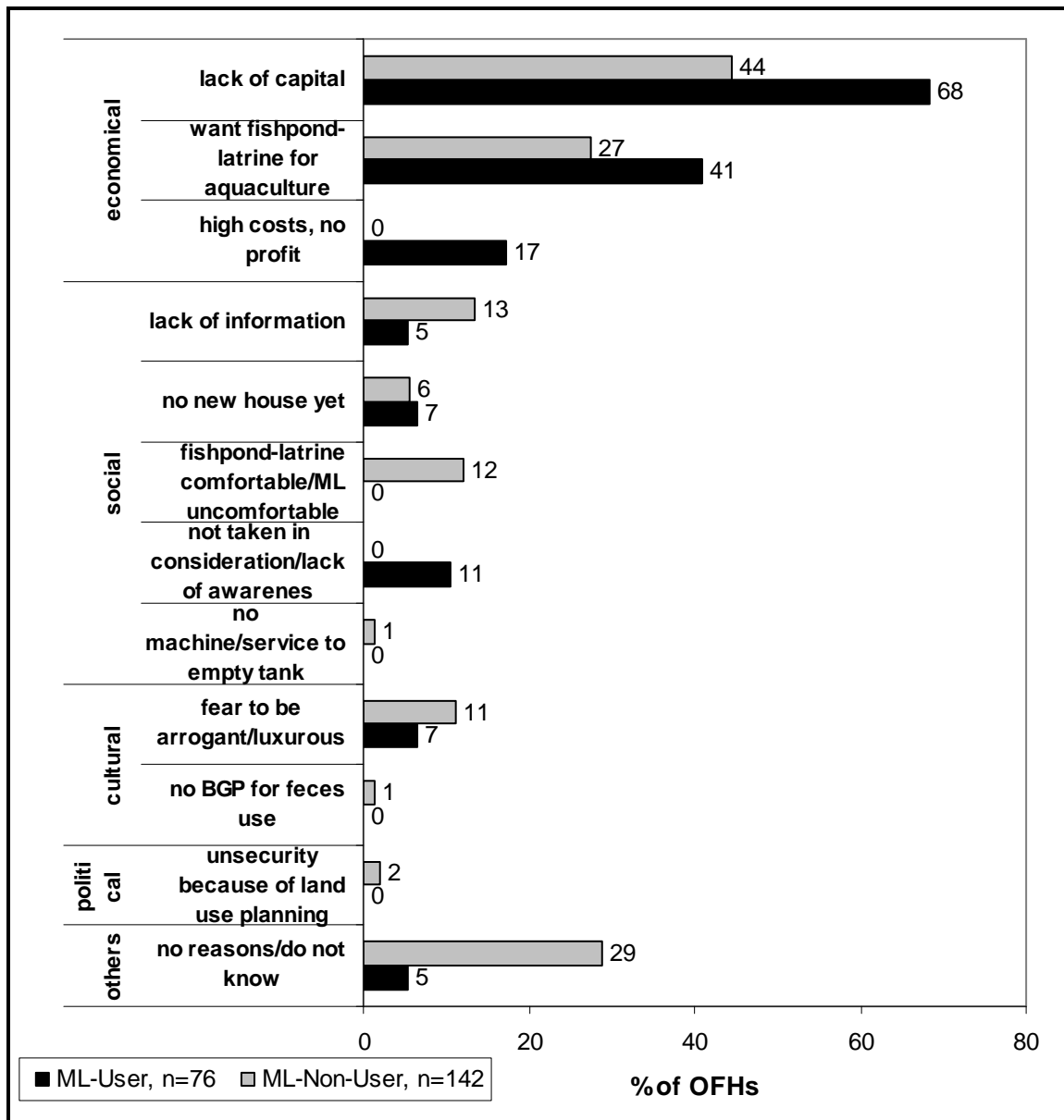
**Figure 5-66 : Valuation of ML-Construction Aspects**

\*This is an additional assessed statement made uniformly by 17 respondents of the ML-Non-Users. Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

As in all assessments, both user-groups had the possibility of additionally free statements. Thus, 17 respondents of the ML-Non-Users mentioned uniformly that a solution to empty the tank easily is very important. Hence, for a part of the OFHs the herewith related reuse of human excreta seems to have very high importance. Otherwise this statement may be founded by the apprehension that the ML gets stuck as soon as the tank is full. However, both issues would be satisfied through connection of ML to BGP and can be used as a positive synergy effect of the system. Recapitulating, safety and comfort especially for children and elderly, privacy as well as the avoidance of conflicts with neighbors are dominating motivations. The political influence by passed decrees (*cp. Figure 5-38*) plays a role and people's conscious make the improvement of hygienic and environmental conditions additional important aspects to invest and use ML.

### 5.9.3 Constraints for Investment, Use and Connection

In order to become aware of further important details for ML acceptance this chapter presents the analysis of constraints. ML-Users (average of 1.6 votings) were asked for their opinion about the reasons the ML-Non-Users may have not to invest in the use of ML. These statements are presented in *Figure 5-67* together with the constraints the ML-Non-Users (average of 1.5 votings) mentioned by themselves.



**Figure 5-67 : ML-Non-Users' Reasons against Investment and Use of ML and Estimation of it by ML-Users** (Multiple choice answers possible)

From the ML-Users point of view the economical aspects once again dominate clearly. Secondly, lack of information and thus lack of awareness are estimated key factors for acceptance. These estimations are congruent with the statements of ML-Non-Users. Further determinant mentioned by both OFH-groups is the fear to gain the image to be arrogant or bumptious. The statement to have no new house yet has to be seen economically but also under the socio-cultural point of view to receive a

negative image by investment in ML with a traditional, old house. The ML-Non-Users opinion that ML is uncomfortable probably is based on bad experiences with the first initiative of the GoV to introduce very basic pit latrines, which were not accepted and disappeared rapidly.<sup>33</sup> Last but not least, almost one third of the ML-Non-Users stated that they do not have a special reason against ML. Probably, this bases on the Non-User-OFHs' lack of information as well as on a kind of bashful attitude due to their poor economic facilities leading to the assumption that a ML for their dwelling seems "too far away".

Due to the presented results a selection of original statements is categorized according to major topics as information and technical assistance, aquaculture and profit as well as prestige in *Box 5-10*.

### **Information and Technical Assistance**

- ↪ I don't have ML because I don't know how to solve problem about the waste when it is full. QN 111
- ↪ Most of the farmers don't know that and how to link toilet with BGP. QN114
- ↪ We would like to build ML and BGP, but there is no technical assistance for construction and maintenance and we do not know the way how to get out the sludge safely. QN173

### **Aquaculture and Profit**

- ↪ I like to install BGP and ML but I use the waste to raise fish. QN211
- ↪ People in rural area have large area, so they don't think of building modern toilet. QN116/128
- ↪ If we use the waste to raise fish, it is not good for our health when we eat these fishes (there were 170 people who got strange disease, but we did not know). QN116

### **Image / Prestige**

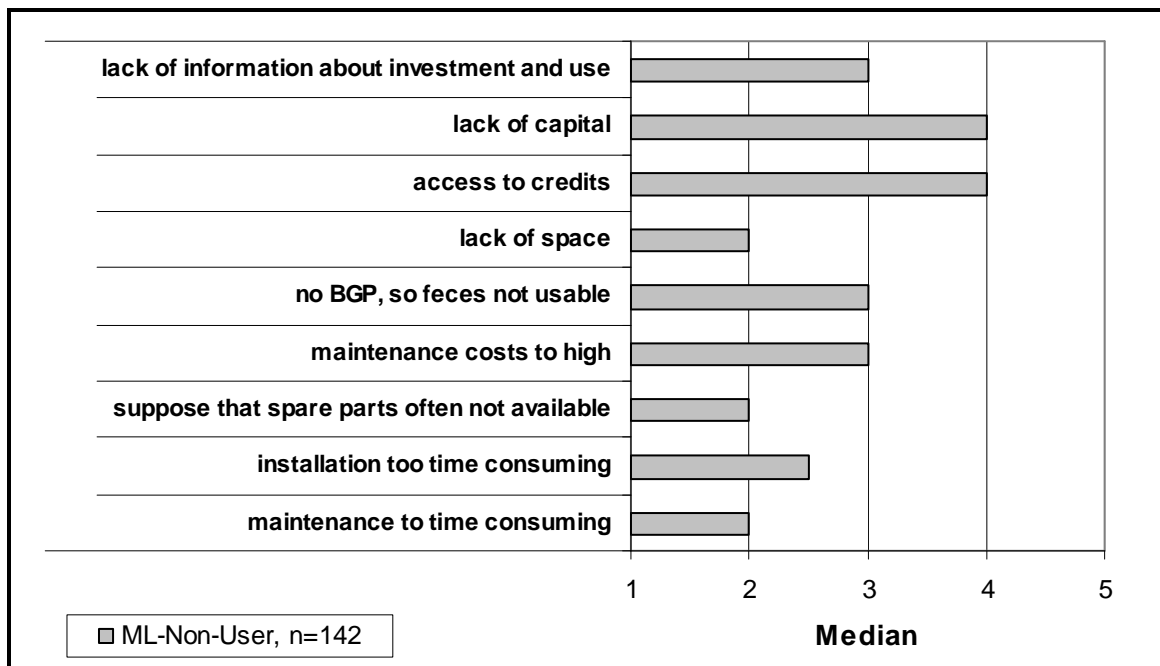
- ↪ I have a thatched house. If I build a ML my neighbor will think that I am arrogant/bumptious. I fear to lose my face! QN205/213
- ↪ When we build modern house we will also build ML because it is more convenient for the elderly and it does look better to other people than the "fish-toilet". QN143

### **Box 5-10 : Verbal Statements – ML**

These statements express the household heads' attitudes and underline the core determinants of information lack and insufficient technical assistance, the missing economical incentive as well as the prestige problem that hamper their acceptance behaviour. At the same time the statements reveal the OFHs' interest in and basically

<sup>33</sup> Information received during interview with Mr. Loi, representative of the Health Center Can Tho.

positive thinking of ML-use. In *Figure 5-68* the ML-Non-Users assessed a selection of aspects referring to the investment and use of ML. The highest values are given to the economic aspects like lack of capital and difficult credit access as well as lack of information in general. Time, space and logistic issues as the availability of spare parts are of less importance. The requirement of a connection to BGP is given a rather high value, which leads to the conclusion that the combination of BGP and ML has good possibilities for acceptance and may facilitate the acceptance rate.



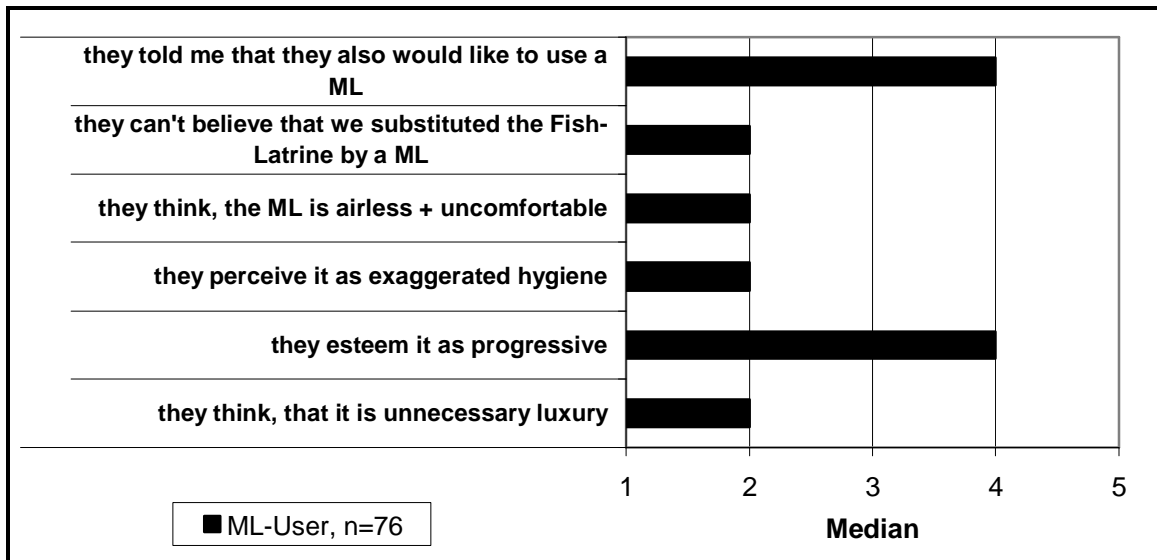
**Figure 5-68 : ML-Non-Users' Assessment of Aspects against Investment and Use of ML**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Summarizing, the major constraints are defined in the lack of information, which includes a broad range of technical issues. In addition the lack of capital in cash or credit closely linked to the socio-cultural aspect of inappropriateness (social incompatibility) to have a ML but not a modern or well-off house.

#### 5.9.4 Acceptability

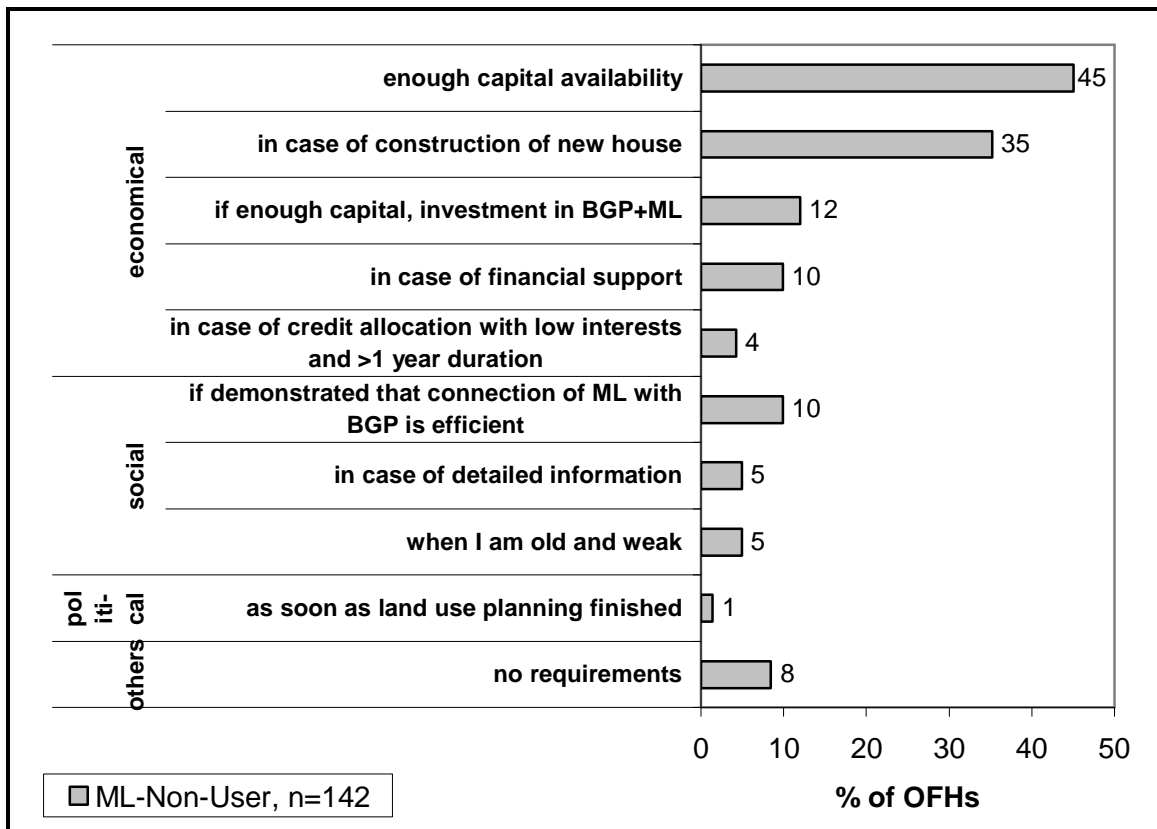
The results of the analysis regarding reasons for and against the investment and use of ML have revealed already that for OFH without a modern house the prestige can be a determinant to hamper the acceptance of ML. *Figure 5-69* demonstrates the assessments of various statements suggestively done by ML-Non-Users through ML-Users. The appraisal of attitudes is definitely in favor for ML. The ML-Users are rather sure that the other OFHs perceive the use of ML as progressive, and that they would like to use ML if possible. The prejudices of construction failures and gain of bad prestige are estimated as of relatively low importance.



**Figure 5-69 : ML-Users' Estimation of ML-Non-Users' Attitudes towards Investment and Use of ML**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Finally, the ML-Non-Users (average of 1.4 votings) were asked, which conditions/requirements are needed that they would invest in a ML. The accumulated statements are presented in *Figure 5-70* and the order of the principal three requirements is congruent to the single priority of votings.



**Figure 5-70 : ML-Non-Users' Requirements for Investment in ML** (Multiple choice answers possible)



These statements confirm the principal determinants discovered in the detailed analysis before. Economic issues in their broad range (credit, new house, subsidies) but finally lack of capital, have highest value to enhance the acceptance behavior of ML. Secondly information and demonstration needs to be improved to raise the acceptance rate. Furthermore, OFHs with elderly and children will easier accept to invest and use if they have the opportunity. And, the living condition in general, especially the condition of dwelling, is a determinant for acceptance to preserve their prestige.

### ***5.9.5 Summary of the Findings and Conclusions for Acceptance of ML***

The appearance of ML is still very low, degrading from suburban to rural area. In the rural sites of Long Tuyen and Hoa An about 80 % of the surveyed OFHs have no ML, 10 % no latrine at all. In the scope of the NRWSS' goals, the introduction of ML to improve the rural sanitation conditions is a key issue. Under cultural aspect, ML-use holds no problem (30 % of ML-Non-Users do not have reasons against ML-use), is esteemed as progressive and most of the ML-Non-Users wish to have one in the future. But restraining factors for investment and sustainable use do exist. The consolidated tradition to use fishpond-latrines predominantly relies on the agro-economic importance for aquaculture. In the following, the ML-use's present conditions including ML-models, knowledge and finance issues as well as the evaluation of perceived advantages, constraints and according requirements composing the ML-Non-Users' attitudes and ML-Users' acceptance behavior for investment and use are summarized.

#### **Principal Aspects of Present ML-Use**

Most common are MLs with septic tank and DVC latrines mainly introduced with subsidies by UNICEF, NGOs or CTU in cooperation with the Health Centre. The Rural Extension Service is not involved. Costs of ML may range from 450,000 VND to several million VND depending on model, quality/luxury of construction.

About 80 % of both OFH-groups received some kind of demonstration through their direct social environment (neighbors, friends, relatives). Other entities hardly play a role for communication/demonstration of ML. This may be explained by the subject's sensitivity and that these contacts live in urban areas using ML already.

ML credits are credits for construction (normally 1% per month) which allow a longer time of repayment (up to 36 months). But less than 7 % of the MLs are financed by credit. Investment in ML is closely linked not only to capital availability but construction of new house in sense of image discrepancy.

### **Determinants of ML Acceptance for Investment and Use**

In conclusion of the analysis on advantages/motives, constraints and requirements for investment and use of ML, the resumed determinants presented in *Table 5-4* are listed according to their assessed importance for the OFHs' acceptance behavior.

<b>ML-Non-User</b>	<b>ML-User</b>
<b>Major Perceived Advantages / Motives</b>	
<ol style="list-style-type: none"> <li>1. Sufficient available capital, construction of new house</li> <li>2. Security/comfort for elderly /children</li> <li>3. Improvement of hygienic conditions</li> <li>4. Received sound information / demonstration</li> <li>5. Contribution to environmental protection</li> <li>6. No space for fishpond</li> </ol>	<ol style="list-style-type: none"> <li>1. Security/comfort for elderly /children</li> <li>2. Improvement of hygienic conditions</li> <li>3. Contribution to environmental protection</li> <li>4. Input source to run BGP</li> <li>5. No space for fishpond</li> <li>6. Sufficient available capital, construction of new house</li> </ol>
<b>Major Perceived Constraints</b>	
<ol style="list-style-type: none"> <li>1. Lack of capital (cash and credit access)</li> <li>2. Preference of fishpond-latrine for aquaculture</li> <li>3. Lack of information / existing prejudices</li> <li>4. Fear of arrogant image / no new house</li> <li>5. Difficult emptying / reuse of feces</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of capital (cash and credit access)</li> <li>2. Preference of fishpond-latrine for aquaculture</li> <li>3. High costs, no profit</li> <li>4. Lack of information / existing prejudices</li> <li>5. Fear of arrogant image / no new house</li> </ol>
<b>Major Perceived Requirements</b>	
<ol style="list-style-type: none"> <li>1. Sufficient capital / new house</li> <li>2. Customized microfinance system / subsidies</li> <li>3. Sound information /demonstration about ML and connection to BGP</li> <li>4. Technical assistance</li> <li>5. Construction issues (easy emptying, ventilation, close to the house)</li> </ol>	<ol style="list-style-type: none"> <li>1. Customized microfinance system</li> <li>2. Profitability</li> <li>3. Sound information /demonstration about ML and connection to BGP / proofed efficiency</li> <li>4. Construction issues (easy emptying, ventilation, close to the house)</li> </ol>

**Table 5-4 : Determinants of ML Acceptance**

The listed determinants of ML-Non-Users' attitudes and ML-Users' acceptance behavior are quite congruent in their subjects and priorities. Hence, within the following topics conclusions and first recommendations are summarized.

### **Construction Requirements and Management**

The security, specifically for elderly and children during the night as well as the comfort especially if raining, are perceived as very valuable attributes. Nevertheless, strong doubts referring to the emptying procedure (functionality, service and costs) of the ML tank and sustainable use do exist. The ML-connection to BGP provides an efficient solution with synergy effects as the emptying procedure is superseded, night soil can be reused and in addition the strong dependency of BGP-utilization on piggery is alleviated. In conclusion, the communication and demonstration of BGP and ML connection to compose a wastewater management system bears high potential to improve the acceptance rate of both innovations and needs to be promoted appropriately.

### **Finance and Credit**

Most of the MLs are financed by cash or credits with subsidies of NGOs. The consolidated tradition to use fishpond-latrines relies on the agro-economic importance for aquaculture. People perceive the ML as part of a new house but not worth an independent investment, even less by credit. The possible relation of saving health care expenses due to improved hygienic and environmental conditions is too far. Hence, an economical stimulation to motivate people to invest is missing. The example of the household head investing in sophisticated fishpond-latrines to offer service for others in order to use feces to increase his pisciculture shows that apart from the reasons of comfort, security, hygiene and environment, the immediate economic aspect is vital for acceptance behavior. The connection to PE-BGP is an appropriate approach as night soil is reused and the effluent available for aquaculture. Thus, the OFHs have the opportunity to keep up their habit and income of aquaculture. Further, an improved microfinance system may lead to an additional increase of OFHs' acceptance behavior.

### **Lack of Information**

The opinion of some OFHs that ML is uncomfortable/impractical seems to be based on bad experiences with the first governmental initiative to introduce very low sophisticated latrines (basic pit latrines) and nescience of the ML attributes. Furthermore, the OFHs mentioned lack of information directly that includes ML attributes, requirements to install and opportunity to connect it to BGP, maintenance as well as calculation of feasibility. Due to the approach to integrate ML in the agricultural production cycle, the Health Care Centre and the Agricultural Extension Service should work together on the improvement of communication, people's education and the necessary technical assistance. Here, standardization and general widespread introduction of BGP with connected ML would also reduce the installation and fix costs.

**Image**

Nowadays the OFHs perceive ML as a luxury good that does not fit to their living standard, specifically not to most of the OFHs' dwelling conditions. Further, it could not be reasoned by an economical aspect and thus accepted by the social community. Respectively, the impact on hygienic and environmental conditions seems not to be sufficient. Hence, on the one hand also here, the integration of ML in the agricultural production cycle with economical advantage through connection to BGP might be part of the solution strategy. Secondly, the acceptance can be improved by further education with an open discussion of the subject. Further, an adequate microfinance system may support to reduce the attitude that ML is only accessible for better off households.

**ML Acceptance in the Context of the OFH's Dimensions**

Reflecting the elucidated determinants for ML-acceptance in relation to the surveyed dimensions, the economic and social dimension has highest relevance. In comparison to BGP, the ML does not only require capital but also does not develop economic value for the OFH (as long as it is not connected to BGP). One key-factor is the missing economic inducement of ML. The supposed high importance of the cultural dimension due to the widely spread "habit" to use fishpond-latrines can be denied. It turns out that its economic advantage for aquaculture and low-cost construction are the reasons for its general diffusion. The major motives for ML, security/comfort for children/elderly and improved hygienic conditions belong to the social and medical dimension. But they are not important enough to invest as long as a sufficient living standard allows spending a high amount of capital for the perceived luxury (or remarkable financial support by an institution). This comprehends the key constrain of image, as in many cases a ML is even more expensive than the OFH's dwelling. Combined with the opinion that ML has no economic impact, or even worse, substitutes the fishpond-latrine being an essential component of the integrated farming system, the OFHs cannot imagine to invest in ML. The ecological dimension rather offers an asset for a positive image after the investment than a pushing factor for ML-acceptance. Again, the political dimension sets the legal and institutional framework for implementation. But the authorities cannot abolish fishpond-latrine without offering an appropriate alternative of two functions, safe sanitation and value for the agricultural production cycle.

Finally, among some individual construction details of ML (type, location), the most important concern is the emptying procedure of its tank.

These results lead to the conclusion that first of all the ML-Non-Users suffer great lack of information. In fact, the introduction of ML and its diffusion fails due to its economical and social inappropriateness and insufficient communication of demonstrated opportunities. ML-Users are OFHs which have a modern house and

can afford the comfort or received notable support (finance and/or information) by an institution.

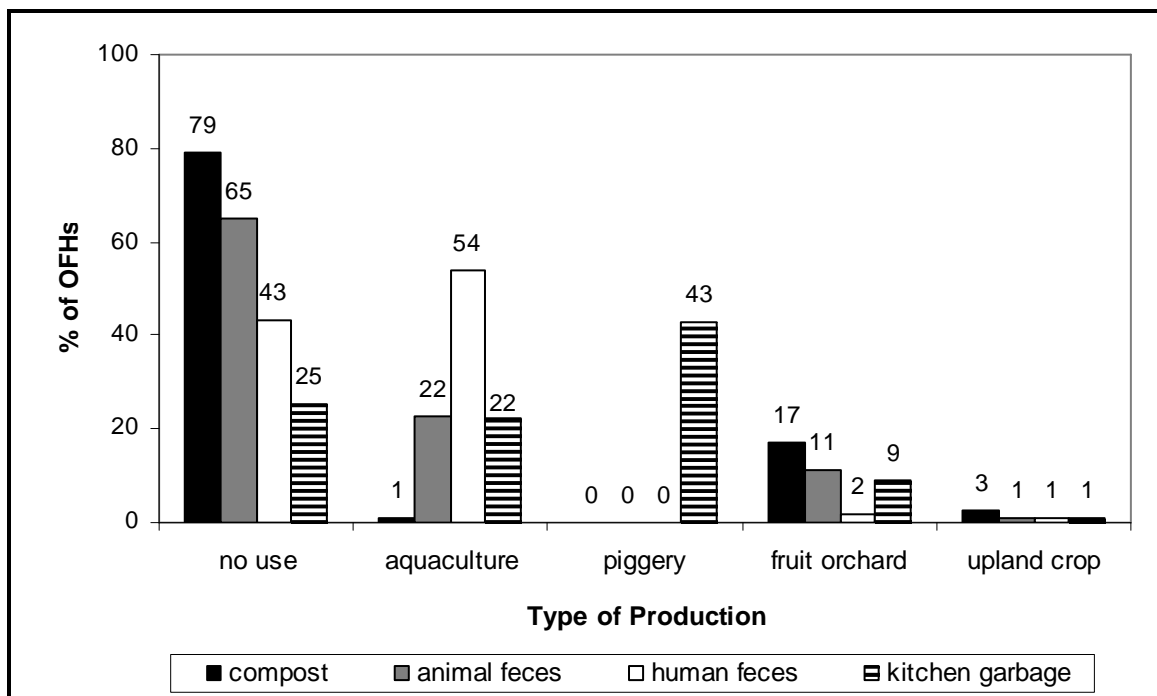
The connection of ML to BGP offers the great opportunity to overcome the hampering factors of both, BGP- and ML-acceptance. This requires building up a communication and service network in order to provide reliable information and assistance on the platform of mass organizations and hamlet authorities attaining the OFHs' direct social environment.

## 5.10 Organic Material / Biogas Sludge – Farmers' Perception of Attributes for Acceptance to Use

In the chapters treating the cultural, medical and ecological dimension some basic information related to the exposure of organic material was presented. This chapter focuses in detail on the use of organic material, especially BGS. Its perceived attributes are going to be analyzed as well as the possibility to raise its value and acceptance of use by the process of earthworm breeding (EWB). Due to the secondary analysis, the use of BGS and human feces are principal unsolved problems in the subject of sustainable and hygienically safe ecological sanitation.

### 5.10.1 Situation of Organic Material Use

For an overview of the use of organic material in agricultural production the OFHs were asked to assign the utilization of different kinds of substrates according to types of production. In case of paddy rice and sugar cane no use at all was mentioned. *Figure 5-71* presents that a high percentage does not use compost, and that two thirds are accustomed to use animal feces in aquaculture and fruit-growing. More than half of the interviewed OFHs use human feces but almost exclusively for aquaculture. That states indirectly the traditional use of the fishpond-latrine. Kitchen slopes are principally reused in piggery, aquaculture and in lower amount for fruit-growing which could be taken as kind of composting.



**Figure 5-71 : OFHs' Use of Organic Substrates for Agricultural Production (n=218)**

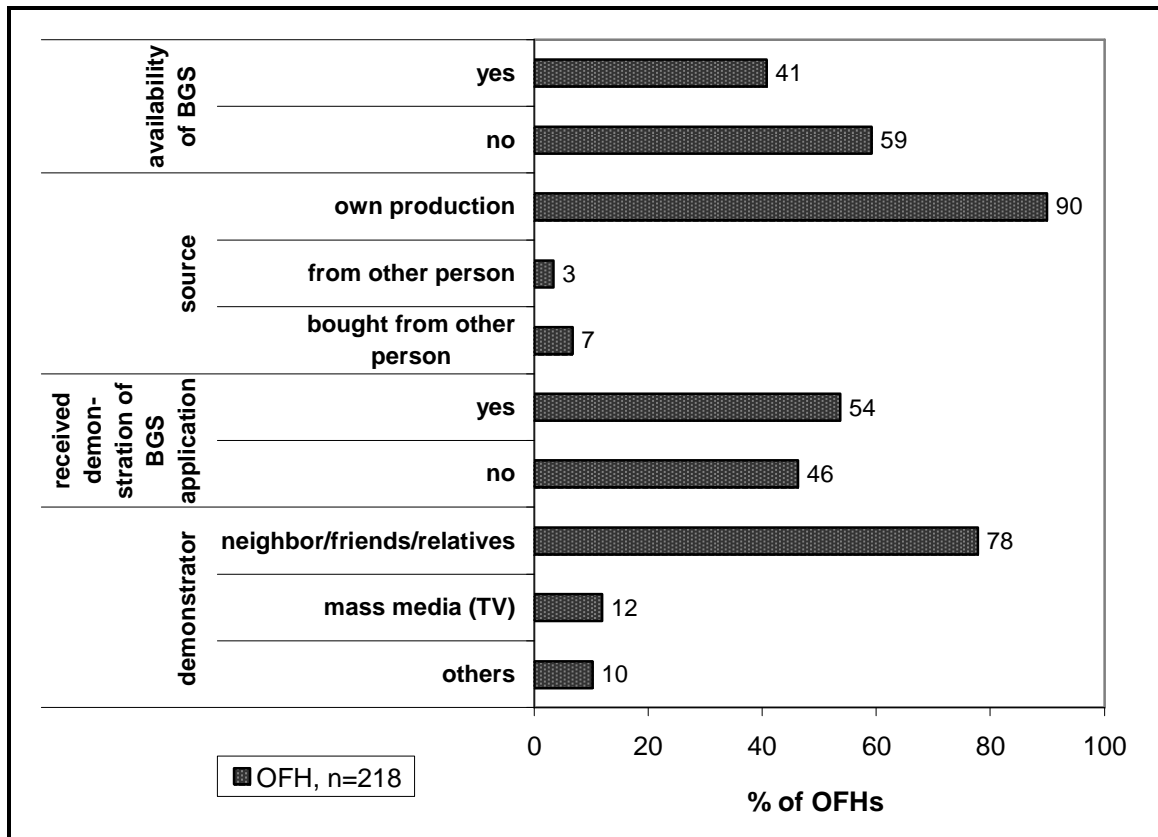
The upland-crops do hardly receive an application with one of these substrates. Due to the observation, upland-crops are located between the water bodies and around the paddy fields. In most cases the distance from the dwelling is too big or

uncomfortable to carry and apply organic material. Instead, for this cultivation the sludge out of the water bodies and mineral fertilizer is used. According to the results of *Chapter 5.3.2* the majority of OFHs in these locations are not accustomed to cultivate vegetable gardens close to the house. Therefore, one major reason is the problem of flooding and in the case of Hoa An, additionally the soil quality (acid sulfate soil).

In the following survey steps, the priority lies on the evaluation of BGS aspects with focus on human feces used for its production. In the literature review the following statement of a man in Northern Viet Nam related to mineral fertilizer and human feces was found: "By using manufactured, modern drugs human diseases may be treated quickly, but these drugs treat only the symptoms. Traditional medicines are more effective because they attack the root causes of diseases. When we use human excreta to fertilize tobacco or rice crops, it works more like traditional medicine. You can see that the plants look greener and have more flavors, than if we use chemical fertilizers" (ADCOM 2002: 18). This statement represents the traditional way of thinking. In the South it might be different as human feces are predominantly used for aquaculture. But the question rises whether mineral fertilizer can be substituted at least partly by BGS. What are the reasons and constraints of its utilization and how is the attitude referring to the consumption of products produced with organic material especially when including human feces?

In *Chapter 5.3.2* it was revealed that the OFHs use high amounts of mineral fertilizers, especially in fruit growing, paddy rice and sugar cane production. Furthermore, the results elucidated that more Non-User-OFHs use mineral fertilizer than User-OFHs and that the latter use BGS in addition with fertilizer or as partial substitute (*cp. Figure 5-29*).

*Figure 5-72* reveals data about the availability of BGS and received practical information of its use. In addition, the sources to get BGS as well as sources of information are evaluated. The results show that BGS is available for more than one third of the OFHs. Thereof 90 % dispose of BGS due to own production. The manner to receive or buy it from third persons is not very common. Over 50 % of the OFHs received some kind of demonstration how to use organic material. In the function of demonstrator the close social environment plays the most important role. It is the easiest and drawn from life information. Nevertheless, informative, educational documentaries on TV are perceived and constitute a second important way of information transmission. According to information of the BGS-Users, organic material (e.g. BGS) without earthworms achieves a market price of 1,000 VND/kg.



**Figure 5-72 : BGS-Users' Supply Resource and Information Access**

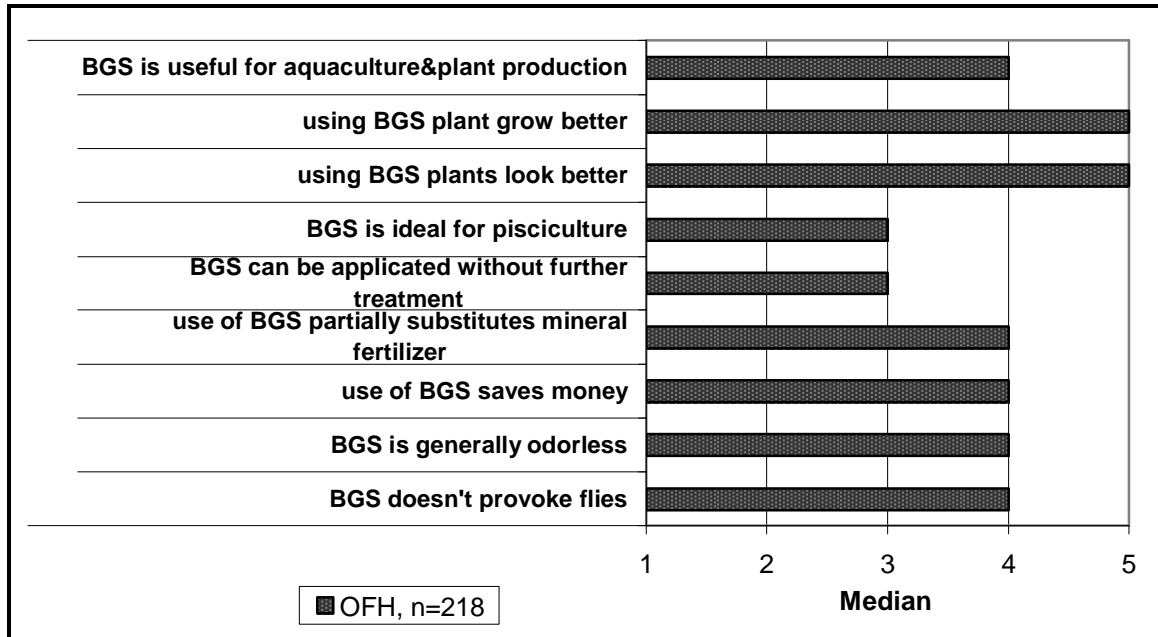
On the platform of this basic information about the situation of organic material use, in the following chapters, motives, constraints and acceptability especially of BGS is analyzed to improve the understanding of this issue and to define key-factors for acceptance behavior of BGS.

### **5.10.2 Motives and Reasons for Investment and Use of BGS**

Biogas sludge can be perceived as “uncomfortable” waste-product of an energy generating process or as a product with various values for different dimensions. This depends on the point of view, the attitude of the OFHs. First of all BGS has to be handled as it is necessary to discharge the BGP input. The analysis referring to ML use has also shown that the issue to know how to empty the tank easily is valued with high importance. Hence, the question is how to do it in the most efficient and profitable way. In order to achieve information about the OFHs' appraisal of BGS, they were asked to value a selection of statements, which refer to different dimensions (*Figure 5-73*). The response of the OFHs reveals that they are highly convinced that BGS can substitute mineral fertilizer partially, thus saves expenses for the latter and has a very good impact on plant growth and quality. Additionally, the respondents strongly agree that the unpleasant characters to provoke flies and to smell badly are rather not true. Regarding the application, the middle value indicates that the BGS requires some kind of treatment. The common practice is elucidated later on in this chapter. Last but not least, in case of a PE-BGP it is principally the



effluent which is used for aquaculture but in some cases the users explained to wash out the complete system into the fishpond once in a while.



**Figure 5-73 : OFHs' Appraisal of BGS Use**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

These results as well as the verbal statements in *Box 5-11* lead to a positive impression with regard to the use of BGS. Although it should be kept in mind that BGS is not a very big deal due to the small amounts of production.

- ↪ I see that quality of BGS and mineral fertilizer is equal, we should combine both. QN80
- ↪ I like to use sludge very much, but other people do not know about its effect. QN199

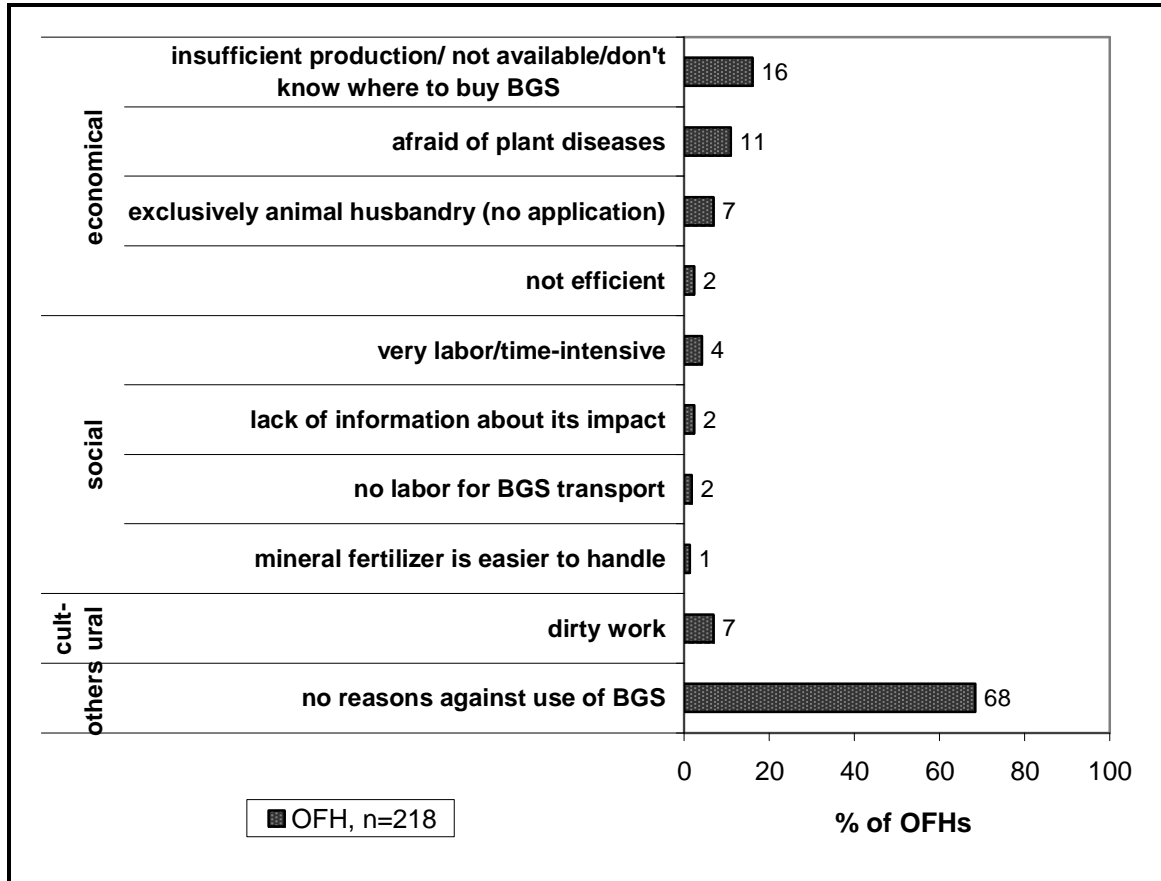
**Box 5-11 : Verbal Statements – Arguments for BGS**

It is to evaluate what kinds of constraints are present in the society and which measures could possibly enhance its production and acceptance to use.

**5.10.3 Constraints for Investment and Use of BGS**

The gained information referring to the motives and positively valued aspects for BGS use gives an open-minded impression of the OFHs. On this background it is essential to find the factors that hamper the acceptance of BGS use. The OFHs were asked to state the three factors of main importance according to their priority perceived as most constraining for BGS use (average of 1.2 votings). The added up votings keep the same order as under each single reason. As presented in *Figure 5-74* two-thirds of the OFHs do not have any reason against BGS use. This indicates that many OFHs seem not to see any necessity or advantage by BGS use as only

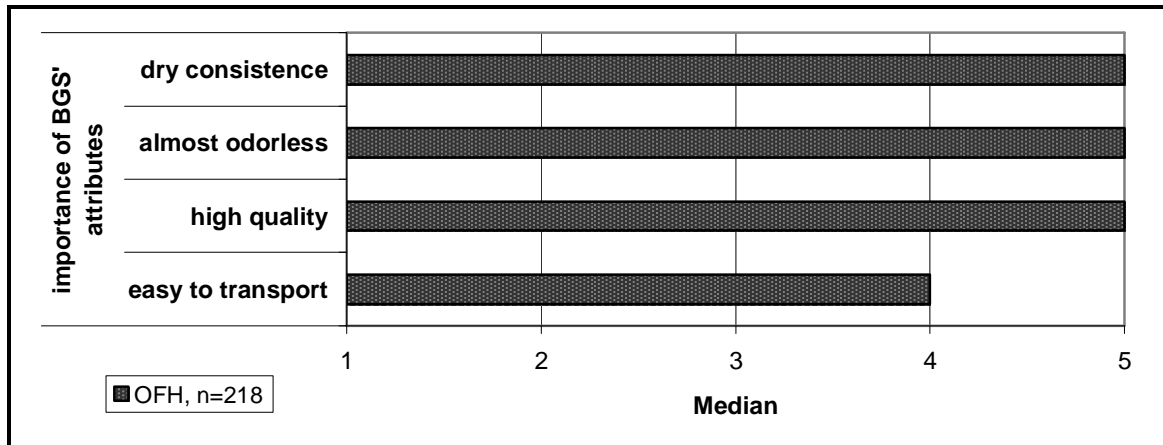
one third does use BGS (*cp. Figure 5-23*). The results reveal that for a considerable number of OFHs BGS is not available at all and the fear of plant diseases is quite high. Latter may be a prejudice and traced back to lack of information which is also mentioned directly by the respondents.



**Figure 5-74 : OFHs' Reasons against the Use of BGS** (Multiple choice answers possible)

The household heads do not have information about impact and efficiency, the real rate of possible substitution for mineral fertilizer. This is a complicated issue as the nutrient content depends very much on the input substrates for BGP which vary in type and quantity. But an easy calculable table to receive information about the approximate nutrient content would be a great step forward to improve the information quality.

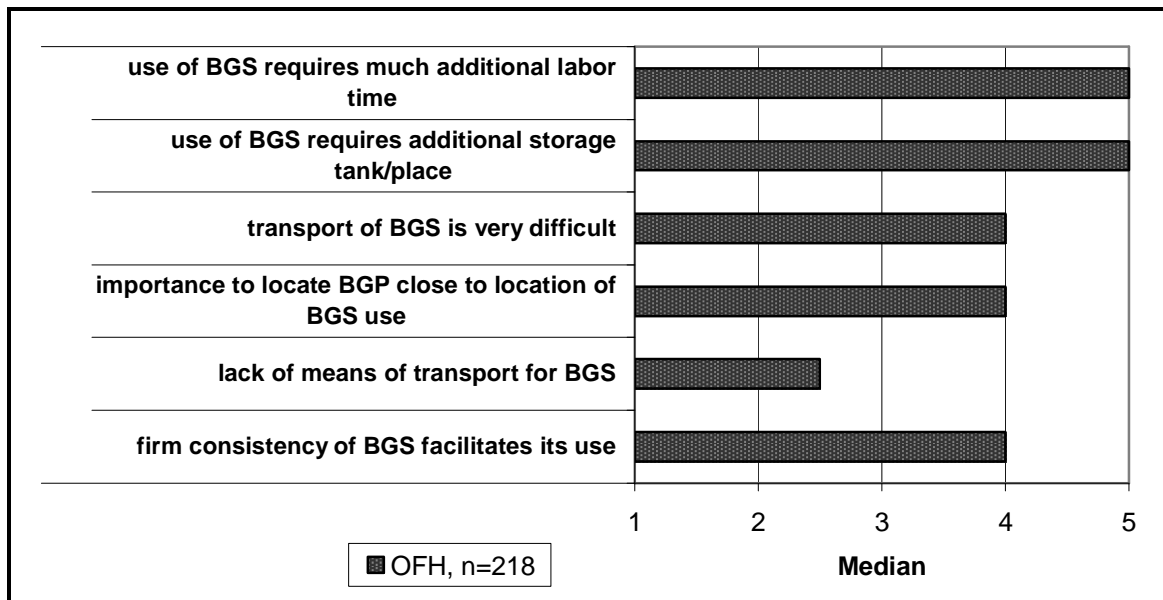
The remaining statements refer to the socio-cultural issue of the ease of use. According to the latter, the attention is drawn to the importance of certain attributes for utilization of BGS that are valued by the OFHs and presented in *Figure 5-75*. Except the ease of transport, all selected attributes are valued at the highest grade.



**Figure 5-75 : OFHs' Assessment concerning the Importance of BGS' Principal Attributes**

In this assessment the respondents were asked for the importance of attributes for the handling of BGS on a scale from 1 to 5. (1) unimportant, (2) less important, (3) more or less important, (4) rather important, (5) very important

Consequently, the respondents want the BGS to be dry for easier handling. The aspect of transport may depend very much on the location and type of use. Due to the fact that the handling, the ease of use, is known as a general core aspect for rejection, further statements were assessed concerning details respectively. The results in *Figure 5-76* indicate the very high perceived requirements of additional time (which also means workload) and space. In many cases the land parcel is so intensively used that there is no space left for an additional installation.



**Figure 5-76 : OFHs' Assessment of BGS' Ease of Use**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

Not for nothing the PE-BGP tank is placed in the pond. It is to save space and secondly to profit from the effluent for aquaculture. But those OFHs that do not have a pond lack of this solution opportunity and additionally face the problem not even to

dispose of a fishpond-latrine. Furthermore, transport of BGS is a perceived problem. All aspects related to the difficulty of BGS transport are highly valued except the means of transport. This implicates that the respondents do not see a transport solution on the aspect of means but on the materials' attributes (*Appendix 5-5*). The selection of statements listed in *Box 5-12* describes and underlines the common practice to solve the handling and transport problem.

- ↪ I mix sludge with mineral fertilizer to apply afterwards. That saves one activity of labor. QN189
- ↪ I put the BGS into a bin to bring it out in the garden. QN19
- ↪ I scoop out the waste with a pannier and let it dry in a hole until it does not smell anymore and then mix the sludge with ashes of rice husks. QN128

**Box 5-12 : Verbal Statements – Handling Practices of BGS**

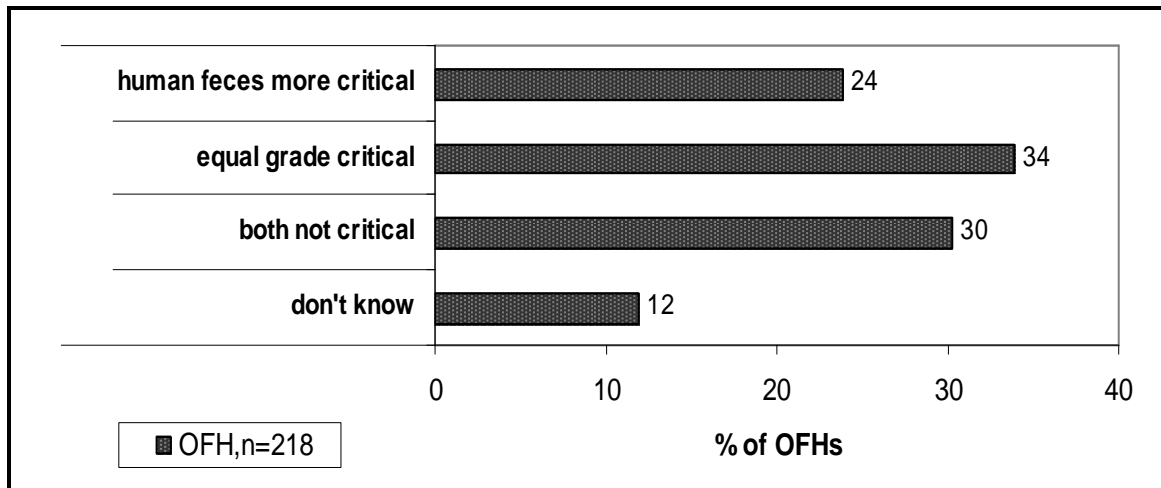
These practical manners to treat BGS are not the worst but the drying process entails a loss of nitrogen, one of the principal plant nutrients. Additionally, nitrogen in organic material cannot be used by the plant immediately. By comparison mineral N-fertilizer allows N-uptake very quickly. In conclusion the mixture of organic and mineral fertilizer might be a very effective way of application, supposing that the nitrogen of mineral fertilizer does not get fixed by the organic material. The nutrient content and impact of organic fertilizer and hence, the best way of application is still a task for research. In the scope of SANSED-Project it could be proofed that the process of earthworm breeding has a significant impact of sanitization as the concentration of *E. coli*, Coliformes and Salmonellae are reduced (FUCHS 2005: 39f).

In order to minimize the BGS transport distance the location of production (BGP) and use (orchard, upland-crops, etc.) should be close to each other. But in many cases this seems difficult as the BGP has to be close to the piggery and in case of ML connection, to the house as well and the OFHs are not accustomed to cultivate in farmyards. In conclusion, the majority of OFHs do not have an aversion to use BGS and constraints like odor, fear of plant diseases and impact can be solved through information and professional education on these aspects. The estimated constraints to handle and transport BGS were confirmed and require new technical solutions or/and an adaptation in the production process in order to achieve higher acceptance rates by the OFHs.

#### **5.10.4 Acceptability**

In the earlier chapters referring to motives and constraints some points have been mentioned already that also fit to the subject of acceptability (handling/ease of use). However, in this Chapter the priority lies on probable rejection due to the use of human feces for BGS production. In conclusion doubts to consume foods produced with BGS as well as the acceptability in meaning of prestige are surveyed. In *Figure*

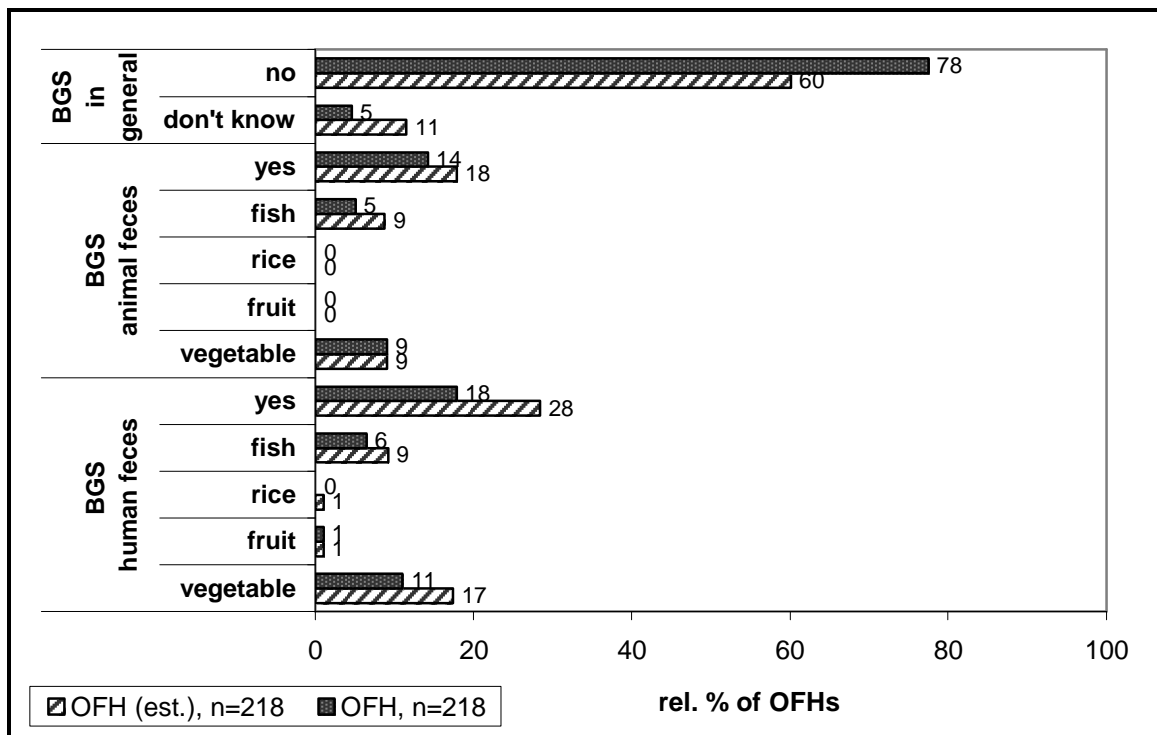
5-77 the results of the appraisal illustrate whether it is more questionable to use BGS produced by human or animal excrements. Despite the fact that the majority of respondents did not perceive any reason not to use BGS, more than half of the OFHs value its use as critical and a quarter perceives BGS out of human feces as even more critical to use.



**Figure 5-77 : OFHs' Appraisal to Use BGS Produced by Human vs. Animal Feces**

In addition to these results it is necessary to go more into detail concerning the doubts of use with regard to the type of produced food and to clarify if there is a significant difference between human and animal excrement based BGS. The household heads were asked for their own attitude and secondly, what they know about other persons (estimation) referring to have generally scruple to consume food produced by BGS. In the case of existing scruple it was divided between human and animal excrements according to the principal products.

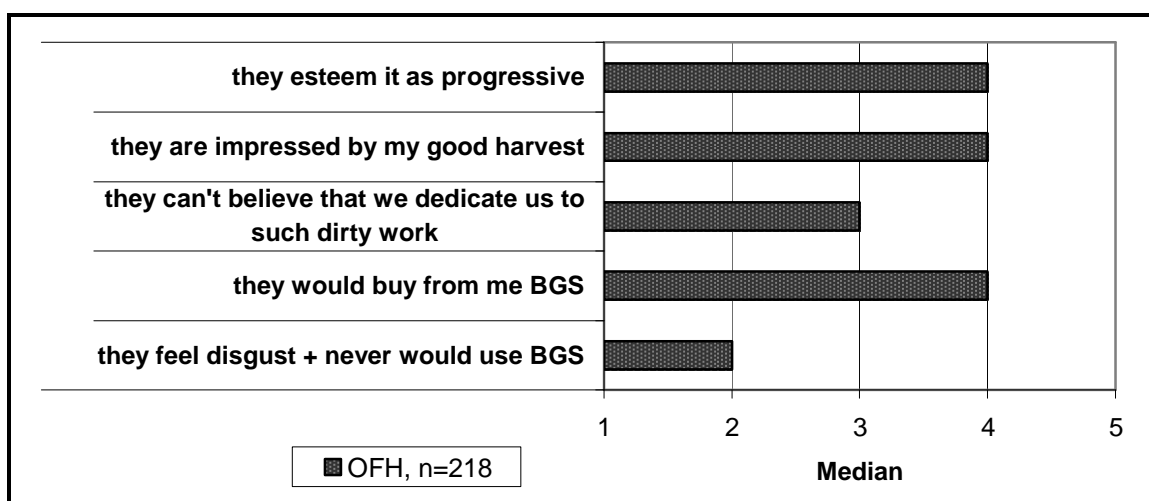
The presented results in *Figure 5-78* indicate that the respondents estimate the other people to have more scruple than themselves. However, two-thirds to three-quarters do not have any scruple to consume produced food accordingly. The compunction of the remaining OFHs concentrates clearly on the consumption of fish and vegetable. At first glance this seems logical due to the possible health threat. But taking into account that a fishpond-latrine as well as animal husbandry (pigs, chicken) in a stable above the fishpond is a "traditional standard", this result is quite surprising. It can be supposed that nearly the complete sweet water fish production in OFHs of the Mekong Delta is based at least partially on the reuse of excrements. Correspondingly, the OFHs' rather critical point of view might be influenced by social desirability in the sense of demonstrating their hygienic awareness.



**Figure 5-78 : OFHs’ Scruple and Estimated Scruple of Other OFHs (OFH est.) to Consume Food Produced with Different Types of BGS**  
(Multiple choice answers possible)

However, recapitulating the results in a positive way, the OFHs in their majority do not reject the use of BGS neither have significantly scruple to consume according food. Furthermore, this attitude does not differ significantly between the use of human and animal excrements.

Finally, it needs to be analyzed how the OFHs using BGS feel and if they assume to be disregarded by their society. Hence, the OFHs valued a selection of statements on this issue shown in *Figure 5-79*.



**Figure 5-79 : OFHs’ Estimation of Neighbors’, Friends’ and Relatives’ Attitudes towards Use of BGS**  
Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, partly not true, (4) rather true, (5) absolutely true

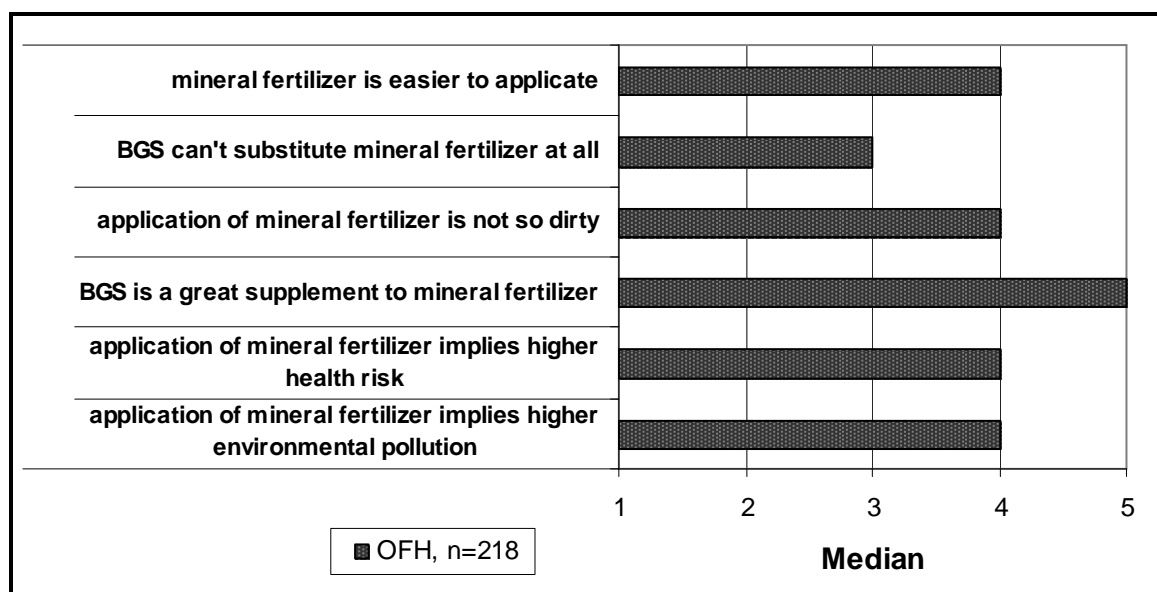
Regarding the image and impact of using BGS as well as the market value, the OFHs estimate a very positive thinking. Merely the aspect of handling BGS and the assumed entailing disgust or rejection are confirmed, but to a low grade.

In conclusion, the motives to use BGS base on the necessity to discharge the BGP input in a most advantageous manner. The OFHs perceive BGS as valuable product for their cultivations and in most cases use it accordingly. They appreciate it at least as fertilizer asset and are convinced that it has a positive impact on the plant growth, although they do not dispose of detailed and proofed information. The approximate calculation of nutrient content and therefore its impact would lead to more certainty and thus, raise the perceived ecological and economic value. Consequently, the interest in and willingness to work with BGS would increase. The results have revealed that the assumed higher rejection to include human feces for BGS is evident but to low degree. The constraints of unpleasant consistency, handling and transport are relatively strong and difficult to solve in general. Apart from an optimal location of all production units other technical options might be possible if the frequency of emptying and/or the amount of BGS would be higher. In most cases the available quantity does not allow higher investment of time, workload, space and probably facilitating means for storage and transport. Pooling together the BGS production might be an approach worth to be discussed in some localities.

In the following chapter BGS is compared directly with mineral fertilizer in order to achieve more information about advantages and disadvantages in case of partial substitution. Additionally, EWB is evaluated basically in order to pre-estimate the value of this treatment for enhancement of BGS acceptance.

### **5.10.5 Alternatives**

As already mentioned in *Chapter 2*, the only competing alternative to BGS (actually BGS is an alternative to mineral fertilizer and not vice versa) is mineral fertilizer. However, the intensive use is one of the major environmental problems and has been analyzed before. At this stage the OFHs were asked to assess a selection of statements in a comparison between BGS and mineral fertilizer. *Figure 5-80* shows no clear preference for one of both. Rather it approves a high importance of the mineral fertilizer's comfort of application. On the other hand the OFHs highly value the problem of health risk and environmental pollution by its use and thus, show high conscious of these problems.



**Figure 5-80 : BGS-Users' Assessment of Mineral Fertilizer vs. Organic Fertilizer (BGS)**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, (4) rather true, (5) absolutely true

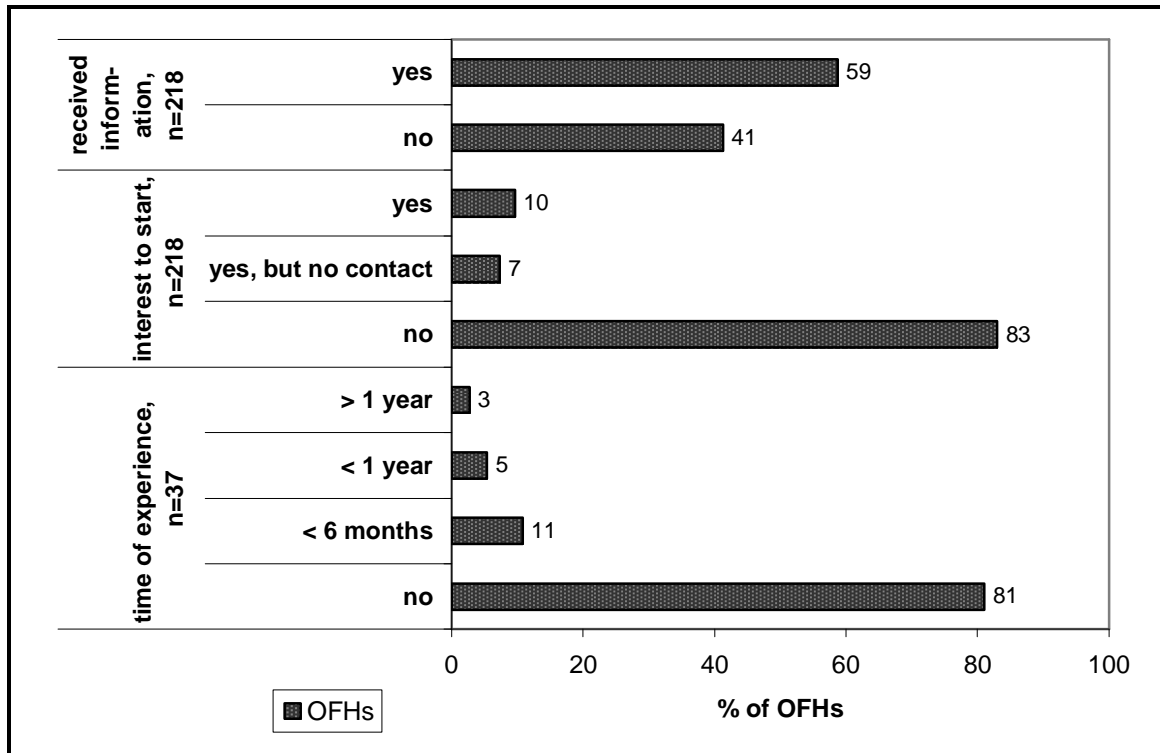
Together with the fact that the production of BGS is very low in relation to the needed amount to substitute mineral fertilizer and that the information about the BGS' efficiency and impact hardly exists, the respondents appreciate BGS as a very valuable supplement to mineral fertilizer. Although the production of BGS will rise with an increase of BGP (and connected ML) a full replacement of mineral fertilizer is not realistic or desirable. The objective should be to reduce its use to a much higher degree. Thus, the question rises whether it is possible to improve the BGS' efficiency and value.

Although earthworm breeding (EWB) is no real alternative but probably a quality and value improving measure for BGS, it was decided to be surveyed under this point of view (*Appendix 5-5*). It was seen as an important aspect to find out more about attitudes and acceptance of EWB as an easy additional process for BGS to make the substrate more competitive to mineral fertilizer.

Lumbriculture impacts and advantages can be considered by the improvement of the substrate structures for both, transportation of the material as well as for the benefit of soil and plant. Furthermore, the earthworms are valuable in a mix of the organic matter and as a single product. According to the respondents, earthworms (clean) have a market value of 180,000 VND/kg, organic material with earthworms are sold for about 18,000 VND/kg and in comparison organic material (e.g. BGS) without earthworms achieves a market price of only 1,000 VND/kg. Thus, the pure economic value of earthworms is relatively high. Due to these prices earthworms and the improved organic material should not be seen as appropriate fertilizer for large scale cultivation. In the survey locations small sized vegetable gardens close to the house are not very usual. But for OFHs with flower and fruit seedling production as well as



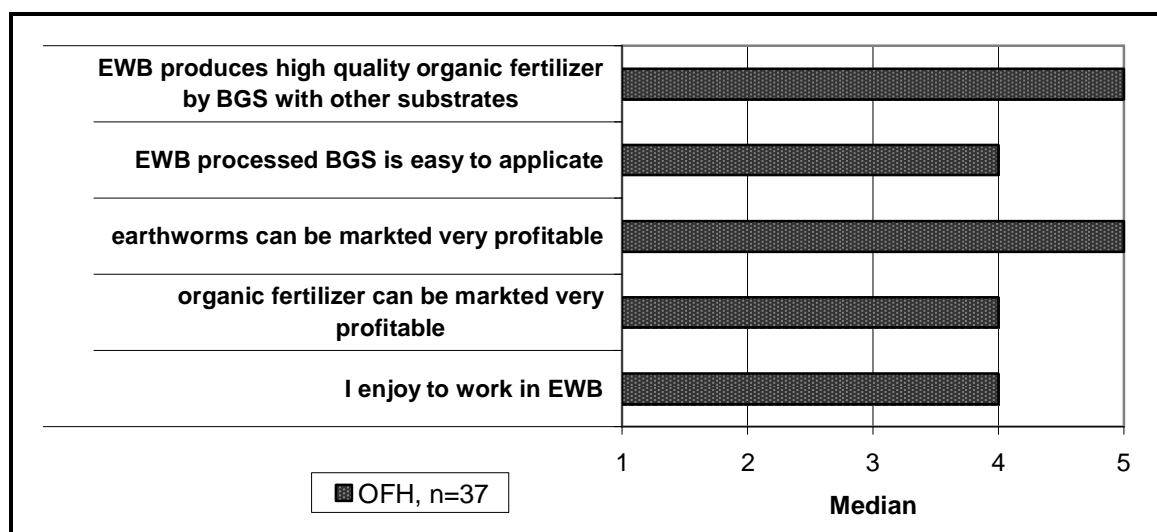
bonsai nursery which are rather common due to the cultural and religious based market (e.g. ancestral altar, orchard grave, Chinese New Year “Têt”), high quality organic fertilizer is very valuable. *Figure 5-81* outlines the OFHs’ situation of received information about EWB, their interest to start with it and previous made experience.



**Figure 5-81 : OFHs’ Attitudes towards Implementation of Earthworm Breeding**

At least over one third of the respondents received some kind of information about EWB. Although it could be found out that this information in most cases is very basic and ends with the knowledge level that there are OFHs producing earthworms which are good for the soil structure. However, 37 household heads expressed their interest to start with or intensify EWB. Thereof only seven OFHs disposed of some experienced time.

In conclusion, the OFHs which mentioned their interest on EWB were asked to value a selection of statements that reflect their disposition and attitude towards EWB. *Figure 5-82* demonstrates the complete range of very positively valued statements referring to the belief in the product, its handling and marketing as well as the emotional attitude. Thus, almost 20 % of the interviewed household heads do not have any aversion of EWB but dispose of a very positive attitude to start or intensify EWB.



**Figure 5-82 : OFHs' Assessment of Principle Aspects of Earthworm Breeding**

Median on a scale from 1 to 5: (1) absolutely not true, (2) rather not true, (3) partly true, (4) rather true, (5) absolutely true

These results show that EWB is at its first steps and requires intensive information dissemination including on-hand demonstrations as well as further start-up assistance. Referring to this, EWB started to be promoted recently. According to information of the PC in Long Tuyen, the Extension Service on provincial level supports 40 % of the costs of the first kilogram of earthworms (accordingly 1 kg costs approximately 108,000 VND) to facilitate the start up. But apart from a television documentary no demonstrations or further information or training activities have been realized in the research sites yet. There is no well-organized communication of these opportunities. These facts convey the impression that representatives of upper institutions may be aware of the importance and opportunities of EWB, but activities are realized only eventually and without structure of defined, consecutive objectives. This fleshes out the impression given of the Extension Service already discussed before (*cp. Chapter 5.8.2.1*).

### **5.10.6 Summary of the Findings and Conclusions for Acceptance of BGS and EWB**

Biogas sludge (BGS) is considered as a third innovation of the survey's potential wastewater system. The NRWSS seeks the improvement of rural hygienic and environmental conditions with the consequence to abolish the use of untreated feces and to reduce applications of mineral fertilizer in agriculture. Thus, the main focus is on BGS acceptance according to the input (animal and/or human feces), its potential to partially substitute mineral fertilizer and earthworm breeding (EWB) as acceptance improving practice. The major results of the BGS and EWB acceptance analysis are resumed in the scene of all surveyed OFHs. Due to the recent introduction of BGP in most cases and the dominance of PE-BGP, running with a steady material flow, the emptying frequency and thus, BGS production quantity is unexpected low. Thus, BGS does not feature an important economic inducement except effluent/BGS for aquaculture. However, two thirds of the OFHs do not have any specific reason against BGS-use. The esteem of BGS is progressive by most of the OFHs and valued as good supplement to mineral fertilizer. The summary is structured in results on the present BGS and EWB use, the determinants of OFHs' attitudes and acceptance as well as conclusions respectively.

#### **Principal Aspects of Present BGS-Use and EWB**

Untreated animal and human feces are predominantly used for aquaculture and fruit growing. About 50 % of the OFHs received some kind of demonstration about using organic material mainly by their direct social environment (neighbors, friends, relatives). Mass media and other institutions play a subordinate role. The distance to upland-crops is too far for BGS application. Almost 60 % of OFHs received basic information about EWB (only on TV); 3 % dispose of previous experience and 17 % are interested to practice EWB.

BGS without earthworms can achieve a market price of 1,000 VND/kg, earthworms (clean) 180,000 VND/kg and BGS with earthworms 18,000 VND/kg. The Province Extension Service substitutes 40 % of the initial kilogram of earthworms as start-up. About one third of the OFHs have access to BGS; nevertheless marketing is not common due to low market value and low production.

#### **Determinants of BGS and EWB Acceptance for Investment and Use**

In conclusion of the analysis on motives/advantages, constraints and requirements for investment and use of BGS, the resumed determinants presented in *Table 5-5* are listed according to their assessed importance for the OFHs' acceptance behavior.

BGS	EWB
<b>Major Perceived Advantages / Motives</b>	
<ol style="list-style-type: none"> <li>1. Positive effects on plant production</li> <li>2. Reduces expenses for mineral fertilizer</li> <li>3. Improvement of environmental conditions</li> </ol>	<ol style="list-style-type: none"> <li>1. Profitability</li> <li>2. Increase of BGS quality and market value</li> <li>3. Improvement of BGS handling</li> <li>4. Improvement of hygienic conditions</li> </ol>
<b>Major Perceived Constraints</b>	
<ol style="list-style-type: none"> <li>1. Insufficient production / no market</li> <li>2. Lack of information about efficiency / calculation of mineral fertilizer substitution potential and about pretended negative impacts</li> <li>3. Unease of transport / use</li> <li>4. Time, labor and space intensive</li> <li>5. Scruple to consume fish and vegetable produced by BGS</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of information / assistance</li> <li>2. Insufficient production</li> <li>3. Time, labor and space intensive</li> </ol>
<b>Major Perceived Requirements</b>	
<ol style="list-style-type: none"> <li>1. Sound information about BGS impact (nutrients content)</li> <li>2. Increased production</li> <li>3. Improved consistency to facilitate handling /application</li> </ol>	<ol style="list-style-type: none"> <li>1. Sound information, demonstration and technical assistance</li> <li>2. Availability of capital and labor</li> </ol>

**Table 5-5 : Determinants of BGS and EWB Acceptance**

The illustrated determinants of BGS and EWB acceptance behavior show that EWB may be worth to support for the enhancement of BGS acceptance. Within the following topics conclusions and first recommendations are summarized.

### **Knowledge and Research Demand**

The OFHs' knowledge about BGS and even more about EWB in most cases is poor. Some are convinced that the plant production improves in quality and quantity by application of BGS. However, the estimation/calculation of its nutrients content and therefore degree of mineral fertilizer substitution and finally impact requires further research. As it principally depends on the input sources, it will therefore be difficult to offer reliable generalized information for the farmer. The OFHs claimed lack of information, specifically nescience about BGS-use and EWB. Perceived negative impacts such as causing plant diseases do exist. The Agricultural Extension Service should offer and transmit this information as well as the also directly mentioned necessity of technical assistance. The already exiting start-up support for EWB requires enhanced promotion. Thus, capacity building through professional training, improvement of technical assistance as well as demonstration units is needed.

### **Economic Inducement**

In case of BGS, the production is very low, the impact difficult to calculate and thus BGS is not much more than an asset to mineral fertilizer once in a while. To make it marketable, the quantity needs to be higher in order to justify workload, time and additional storage space. This condition is given in a bigger installation, in case of a cooperative or if somebody starts to collect BGS for further treatment in order to produce a high quality product. EWB achieves a much higher market value. A sales market does exist for high quality material due to the importance of flowers and bonsai trees. The combination of both might be a worthy approach but not on a single OFH level. Although their might be an opportunity to enable the self-interest of some OFHs by promoting small vegetable gardens close to the dwelling, that have to be flood safe. In conclusion, BGS does not constitute a powerful economic incentive for the acceptance of BGP and ML, although it is appreciated. In case of OFHs with aquaculture the effluent/BGS features its economic importance and is possibly the best practice. However, there is still research demand regarding the opportunities and improvement of BGS use.

### **Ease of Use and Image**

Although BGS-use is estimated as progressive, the handling of BGS is a problem and its use provokes considerable rejection. One quarter of the OFHs perceive BGS-use on the basis of human feces compared to animal feces as more critical. Referring to food consumption (fish and vegetable) the doubts respectively show only a slight difference. The present practice to dry and to mix BGS with ashes and/or mineral fertilizer entails a loss of nitrogen content. But there is no competitive alternative as long as the BGS requires transportation. In case of the floating PE-BGP the effluent/BGS is directly drained into the pond. In case of CC-BGP this issue is a major prevailing constraint. According to the farmers, there are two approaches for improvement. Change of the BGS consistency to enhance the ease of handling or an automatically transport without additional workload (floating PE-BGP with effluent/BGS draining into pond).

### **BGS- and EWB-Acceptance in the Context of the OFH's Dimensions**

Considering the findings for acceptance of BGS, they are principally related to the social and economical dimension as well as the innovation's attributes. Due to the difficulty to calculate the impact and economic value, the perceived BGS-value bases principally on how the plants develop after application. Its available quantity is low and sporadic so that experience of utilization emerges slowly. The lack of information, assistance and proof hampers the formation of reliable attitudes. Furthermore, space, time and labor are necessary to improve its low ease of use.

EWB is able to enhance BGS-acceptance by improving its economic value and handling. Also for EWB the social dimension has highest relevance as its diffusion lacks basic information. Most OFHs do not have sufficient information specifically not about its impact or marketability. So far the efforts (information, demonstration, assistance) to introduce this innovation are low and have attained only a small group of "Innovators".

### 5.11 Approach of System-Users' Profile

In the previous chapters differences of User and Non-User-OFHs have been elucidated with reference to the six dimensions as well as their perceived attitudes towards and acceptance behavior of the surveyed innovations. They led to a selection of issues on the level of the objective surroundings, determinants for acceptance as well as to expressed requirements.

Among the evaluated User-groups (BGP, ML) a small group of "Innovators" (System-User, n=21) does exist. These OFHs use the innovations i.e. BGP connected with ML and thus, BGS at least partially produced by human feces. Hence, the question arises about the decisive differences of these "Pioneers" to the other User-OFHs (n=101). What are finally the most relevant dimensions and aspects for acceptance behavior and/or to stimulate the innovations' diffusion process?

Therefore a final cross check reviewing the complete database and photo catalogue has been realized in order to verify possible differences between the System-Users and the other User-OFHs. As result, between the two User-groups no significant deviations to the findings concerning the objective environment as well as the perception of the innovations' attributes have been identified. The results were insofar strongly confirmed as in most cases the System-Users showed the same tendency of results but with even more emphasis.

Among the OFHs' objective environment according to LANGENHEDER'S model for human decision-making, the social and economical dimension emerged as most important. Within the two dimensions the aspects of educational level, living standard, information access and available capital and/or credit access hold the highest relevance. Two thirds of the System-Users have secondary school or even higher education, over 80 % has very good farmstead conditions and a monthly income over 800,000 VND per OFH. Accordingly the living standard is relatively high giving them more security to take a risk of investment. Furthermore, 30 % of the System-Users dispose of a steady non-farm income making more than 50 % of their monthly income. All have piggery, several households own more than 50 pigs. The System-Users' higher tendency to non-farm income sources while maintaining agricultural production, may even support their disposition for acceptance of the innovations. Due to the big livestock property some were obliged to install BGP. In case of BGP, 50 % were financed cash and 50 % by credit. Referring to ML, three quarters invested by cash, the remaining quarter by credits. Consequently, the System-Users having satisfied their basic needs of living standard anyway are in the position to take a risk on their own capital. By comparison, the great majority of OFHs requires more security to satisfy their basic needs and less chancy investment conditions; the present credit conditions seem to be inappropriate. Therefore an

appropriate microfinance system, farmers' professional training and technical assistance are needed.

Furthermore, the System-Users dispose of better household equipment providing more/better communication channels/information access. These are key aspects typical for the group of "Innovators" and "Early Adopters". However, the direct social environment is valued as very important for decision-making. This should be considered for strategies on introducing innovations in the communities in order to achieve high diffusion rates.

In comparison to BGP, the ML does not only require capital but also does not develop economic value for the OFH (as long as it is not connected to BGP). One key-factor is the missing economic inducement of ML. In fact, the introduction of ML and its diffusion fails due to its economical and social inappropriateness and insufficient communication of demonstrated opportunities.

The major motives for ML, security/comfort for children/elderly and improved hygienic conditions belong to the social and medical dimension. But they are not important enough to invest as long as a sufficient living standard allows spending a high amount of capital for the perceived luxury.

The political dimension is important to set the legal and institutional framework for implementation of the NRWSS. The present institutional and political network is strong and offers a good platform to communicate water and sanitation issues. In case of OFHs with big livestock property it is a significant top-down approach for BGP-use which requires the social and economic factors for its sustainability. Accordingly, the authorities cannot abolish fishpond-latrines without offering an appropriate alternative of two functions, safe sanitation and economic value for the agricultural production cycle.

System-Users prevail in active memberships in CPVN and therefore seem to be slightly better informed. But this predominance in socio-political contacts cannot be transferred to the level of Early Adopters/Majority. They need consistent and efficient communication of policies in order to create confidence and reliability for acceptance and dissemination of new technologies. In addition, the definition and monitoring of quality standards for BGP and ML construction are essential for the OFHs' acceptance behavior and reputation that stimulates the innovations diffusion process. The medical, and slightly less the ecological dimension, contains the important aspects of health care, hygienic and ecological awareness. But they are not principally of decisive impact than rather essential for the sustainability of the acceptance behavior. The aspect to reduce expenses for medicines related to the innovations' preventive impact on waterborne diseases is not within reach and thus, requires its sound communication and education of the population. Then, its importance for decision-making might increase.



The issue of environmental protection rather offers an asset for a positive image of the innovations than a pushing factor for the decision of acceptance.

The analysis of the cultural dimension had lowest importance as almost 100 % of the respondents were Kinh people and no specific habits or possible aversion in terms of exposure to water and garbage were detected. For other regions the fact that Khmer people do not use well water for drinking is remarkable. The supposed "habit" of using fishpond-latrines with its roots in the integrated farming system of Chinese ancestors was not verified. In fact, the strong maintenance of fishpond-latrines depends on its economic value and low-cost installation without alternative until now.

The users' perception and evaluation of the innovations' attributes affect to a large extent his acceptance behavior. The economic criteria both, the investment costs and the innovations profitability turned out to be core issues. However, the innovation's ease of use turned out to be another key aspect.

In case of BGP the respondents seem to prefer the CC-BGP due to its durability if they would have enough capital and livestock. But apart from the low costs, the PE-BGP shows much higher acceptance due to its facilitated emptying, specifically if floating in the fishpond. Hence, the economy and the ease of use are decisive criteria.

Regarding the ML, the ease of use is not represented so much in its every-day use. But the ML's tank emptying procedure is very much what the respondents concern. The location close to the dwelling in order to have easy access by family members of all ages needs to be considered.

In case of BGS, as the "non-technical" innovation, its ease of use due to its consistency is determining together with the aspects of available quantity, proved quality and therefore economic value. The analysis of EWB showed primarily a great lack of knowledge inhibiting any further reliable formation of attitudes.

Especially in case of BGS and EWB the lack of information, assistance and proof hampers the formation of reliable attitudes. Furthermore, space, time and labor are necessary to improve its low ease of use.

EWB is able to enhance BGS-acceptance by improving its economic value and handling. Also for EWB the social dimension has highest relevance as its diffusion lacks basic information. Most OFHs do not have sufficient information specifically not about its impact or marketability. So far the efforts (information, demonstration, assistance) to introduce this innovation are low and have attained only a small group of "Innovators".

In this regard, it can be stated that a real diffusion process according to ROGER'S "*Diffusion of Innovation*" was not set in motion for none of the innovations yet. None of the OFHs installed the system due to the innovations' dissemination following own initiative. This issue seems to be the key point. All System-Users were involved and

especially supported in the scope of small projects coordinated by the CTU or/and NGOs. Creditors were solely the CTU and international NGOs. Thus, the pioneers received sufficient information, training and know how to take financial and technical support in order to adventure the risk of investment. They were very well informed about all issues including the political intentions, credit allocation and over all the aspects of BGP-, ML- and BGS-use, in some cases even about EWB. These facts reduce the fear to lose the face or to fall into unmanageable debts. Combining these conditions with the respondents' open-mindedness for innovations in general as well as the interest and power for a progressive development of their OFHs, they decided to invest. The approach to connect ML to BGP is the latest development due to the introduction of ML and their acceptance by OFHs which used BGP already. It is a great opportunity to overcome the hampering factors of both, BGP- and ML-acceptance. But up to now a sound structured approach to communicate the innovations as a wastewater management system providing an efficient solution with synergy effects of all dimensions has not been realized.

In conclusion, the "Pioneer-cases" confirmed the findings of acceptance determinants evaluated through the analysis of Non-Users' attitudes and Users' acceptance behavior.

In addition, to conclude the interviews, all respondents had the opportunity of free comments concerning the interviewed subjects and also other aspects they perceived important to mention or discuss. During the interviews the household heads received a lot of information about the innovations. Obviously this influenced the final free comments. Nevertheless, the broad range of questions and long dialog did not produce disinterest or even an aversion to the subject of BGP, ML and BGS. Accordingly, the respondents put priority on the wishes, suggestions and necessities to improve the information network on the innovations including on-hand demonstrations as well as professional training, environmental education and technical assistance in order to promote the utilization of the wastewater system (BGP, ML, and BGS). Furthermore, they emphasized the need to establish a selection of suited microfinance systems. The subjects to support animal husbandry and to reduce market price fluctuations aim in the same direction. In case of Hoa An, a considerable amount of OFHs expressed seriously their need for hand pumps in order to assure the minimum of fresh water supply. But especially in this community the approach to intensify the use of rainwater should be taken into account due to the critical groundwater quality. Both OFH-groups are interested and open-minded towards the innovations and their opinions are very similar underlining the major findings for sustainable acceptance behavior.

In conclusion, the holistic approach considering the six dimensions of the OFHs was necessary. The socio-economic aspects and the ease of use emerged to be the core

aspects. The assessment on information access, demonstrations, technical assistance and the resulting formation of reliable attitudes towards the innovations elucidated that OFHs' profound knowledge was drastically decreasing in the priority of BGP, ML, BGS and finally EWB. In the cases of Non-User-OFHs the selection entities do not offer sufficient high quality information to enable the formation of attitudes towards the innovations that are appropriate to develop into action for acceptance to use.

The progress of the diffusion process requires building up a communication and service network in order to provide reliable information and assistance on the platform of mass organizations and hamlet authorities attaining the OFHs' direct social environment. An economic calculation defining the time frame and possible profit is needed. The importance of low risk investment is even higher in the case of credit and may be approached by a demand-oriented microfinance-system.

## **6 Conclusions and Recommendations for Sustainable Water and Sanitation Management in Viet Nam**

In the developing world the growing population faces a broad range of problems in providing water supply, food security, as well as in organic and inorganic waste management. Due to the dynamic development of Vietnam's industrial and agricultural sector in the last decade as well as to its growing population, there is increasing evidence of pollution of surface, ground and coastal waters. In general animal manure is discharged uncontrolled into fields and rivers instead of using it as valuable fertilizer. Thus, environmental institutions and governments become aware of the looming fresh water crisis. They have recognized that the reuse of wastewater for agriculture may be a low cost solution in water treatment and at the same time a significant contribution to food production. As result of these circumstances, the "National Rural Clean Water Supply and Sanitation Strategy" (NRWSS) was elaborated as part of the national "Poverty Reduction Strategy Paper" to take responsibility for the UNDP's Millennium Development Goals.

The intention to this study was born during the course and development of the SANSED-Project, an interdisciplinary cooperation between University Can Tho and several German institutes. The SANSED's objective was to identify criteria for a sustainable wastewater treatment system in the Mekong Delta that allows using animal and human feces for agriculture production in a hygienic, economic and ecological appropriate way. This raised the chance for the presented socio-economic study on water and sanitation management respectively to analyze and evaluate the acceptance of new technologies applied in the field of biogas technology and ecological sanitation on the operating farm household level (OFH).

Since the villages of Hoa An, Long Tuyen and An Binh were already partly subject to pre-investigations of various topics in the past, a reliable opportunity raised for such a study. There were several contacts to institutions, the People's Committee of some of the villages and thus, a partly facilitated access to the operating farm households to realize an in-depths survey. Nevertheless, serious climatic conditions, language problems, a limited time schedule and the problematic locating of User-OFHs due to incomplete rosters were hindering factors.

At this background and after a profound pre-study in Viet Nam, the decision was made to follow a holistic approach of this study, applying LANGENHEDER'S decision-making-theory together with KOLLMANN'S use-acceptance-model on the operating farm household (OFH) defined by DOPPLER as socio-economic system. For the survey in the three communities a rather detailed questionnaire aimed to achieve information about the OFHs' objective surrounding composed of six dimensions: social, economical, cultural, political, medical, and ecological. The key objective was to analyze the OFHs' attitudes and acceptance behavior of biogas plants (BGP),

modern latrines (ML) and biogas sludge (BGS) as principal components of a decentralized wastewater management system. Referring to the latter, particularly the use of human feces in the biogas technology was a major point of interest. BGP-use was taken as the principal criteria for the sample selection in three villages of Can Tho Province. Within the stratified, disproportional sample 218 OFHs were interviewed. Additionally expert interviews with representatives of the local government, universities and other institutions were conducted.

### **6.1 Summary of Findings – The Operating Farm Household and its Determinants for Acceptance**

The survey could obtain very detailed data on household level to each dimension and innovation. The most important results of the six dimensions are summarized to offer sound information about the OFHs' environment. Although the social and economical dimension have priority, it became clear that the other dimensions provide important aspects to conclude the holistic review. Subsequently, information on the present innovations' use and the principal determinants to enhance the OFHs' acceptance behavior are resumed in order to enable recommendations on water and sanitation management in integrated farm systems.

#### **The OFH and its Environment**

The average family size of the selected 218 operating farm households adds up to 5.2 persons with predominantly two persons of active agricultural labor per OFH. Principal educational level is primary school increasing from rural to suburban area, the User-OFHs featuring a higher educational level. The average estate size accounts about 1 ha. On average, 10 % of both User-groups are very poor. In the category of poor with transition to break the poverty line is represented by 37 % of Non-User-OFHs, almost twice as much than User-OFHs; vice versa the highest income category (> 1.6 million VND). Farmstead quality is higher and household equipment is more sophisticated in the case of User-OFHs. Nevertheless, TV and radio are available in both household groups to over 80 %, with TV being the principal mass media for information access. As consultants for the general decision making process the family and close social contacts are preferred. The OFHs' mobility rate is high, mainly due to short visits during the Têt-season and in the flood season one third of OFHs works off- or non-farm.

Referring to cash availability and possible livestock collateral the economic conditions of the User-OFHs are rather better off than those of the Non-User-OFHs. Off-farm activities are very scarce. The User-OFHs' dominance of non-farm activities might lead to a more continuous income as important precondition for investment in innovations. Agricultural production is mainly dedicated to fruit growing and rice cultivation. Only 20 % of OFHs cultivate upland-crops and vegetable gardens are almost not present. About 80 % of the OFHs use high amounts of mineral fertilizer

equally to about 10 to 30 % of their annual income. Thus, even a partial substitution of mineral fertilizer by organic fertilizer (BGS) would be of economic interest. More than three quarters of the whole sample have piggery, User-OFHs to over 90 %. Even if the number of heads or age would not be enough to satisfy the required input for BGP, they dispose of the operational base for BGP with connected ML.

More than half of both user-groups raise credits with the bank as creditor. Principal information agent to raise credits is the People's Committee. The screening of the OFHs' creditworthiness is not standardized and none of the villages offers special credit or saving programs to facilitate the investment in BGP or ML. Even the User-OFHs which dispose of better economic conditions confirm that it is almost impossible to get a long-term credit for small amounts.

Concerning water and garbage issues the OFHs are aware of the principal problems. Availability of safe drinking water is critical in many households. All water sources are used during dry and rainy season. Rainwater is preferred due to good taste. Determining difference is the fact that twice the amount of Non-User-OFHs uses surface water than User-OFHs do and vice versa concerning the consumption of well water because of better access to water pumps.

Most current water treatment for consumption is by boiling and an additional treatment with filter (ceramic or cloth), aluminum sulfate or chlorine. Only rainwater often is not treated at all, especially in Non-User-OFHs. The collection, treatment and storage of rainwater should be enhanced, even more with the background of bad surface and groundwater water quality due to salt water intrusion, acid sulfate soil and increasing input of mineral fertilizer/agrochemicals.

The environmental awareness of the respondents is high and principally concerned to water pollution caused by different contaminators, especially by garbage and pesticides in the canals. The increasing problem of garbage from rural to suburban area (population density, change of consumption habits) is evident. Considering inorganic packing, the majority tend to burn it, to fill up the pond or to use it for land reclamation. In the rainy season areas get flooded and a lot of rubbish is released into the river, in the dry season there is increasing pollution by pesticide and fertilizer residues. The respondents state that especially the disposal of garbage is a governmental duty and requires improvement. User-OFHs identify BGP and ML use as valuable environmental commitment. The OFHs' financial conditions and logistic possibilities for appropriate measures are limited and thus, there is little own initiative to change the situation.

The OFHs' hygienic awareness is high as well as the following mentioned commitments of prevention, although the observations lead to the assumption that the realization of hygienic practices is still low. Diarrhea cases are low but scabies and other skin diseases are notably recorded. The availability and access of health care is perceived as good but free service is almost completely abolished. Two-thirds

of the OFHs spend up to 75,000 VND/month for health care and appraise their expenses as high leading to a demand for improvement of sanitary infrastructure. Most of the households know about the governmental intentions to substitute fishpond-latrines and to promote the use of organic fertilizer instead of untreated feces. About one third of the OFHs are active members of the Farmer or Women Union. Principally, the People's Committee, the Agriculture Unit with its sections and the mass organizations for people mobilization are core institutions for information access and transmission as well as technical assistance on introduction of innovations. In case of Non-User-OFHs direct social environment seems to have higher importance for information access. The implementation of the NRWSS needs consistent and efficient communication of its policies in order to create confidence and reliability in the population and to enhance acceptance and dissemination of new technologies. Due to the Doi Moi's change in social and economical aspects, the farm households seem to underlie the beginning of a bigger transitional process. Subsistence agriculture with an additional non-farm income will continue, but in general the farms need to increase in size and/or production intensity including professional training to keep competitive on the market.

Due to the presented living conditions, the principal problems for OFHs' development are the lack of capital, shortcomings in developing professional knowledge and the unstable market conditions. Latter includes both, the fluctuation of agricultural products in general and specifically the very difficult cost-value ratio for piggery. Especially in Hoa An flooding and poor soil fertility state a major problem for agricultural production. Therefore the personal objectives for OFHs' development concentrate on development of animal and fruit production leading to a diversification of agricultural production in order to reduce income risks.

### **OFHs' Acceptance Determinants for Investment and Use**

In conclusion of the evaluation of the three innovations it was found out that in most aspects the perceived and estimated attitudes of Non-User-OFHs and assessed User-OFHs' acceptance behavior are mostly consistent, similar or at least complement one another. In general the OFHs perceive BGP, ML and BGS-use as progressive with a considerable percentage of OFHs having no specific reason against them. But restraining factors for investment and sustainable utilization do exist. Consequently, the OFHs' attitudes and acceptance behavior and their determining factors according to each innovation are summarized in the following.

### **Biogas Plants**

The original model of PE-BGP costs 800,000 VND with the recommended concrete base and coverage up to 1.5 million VND. In course of the survey none of the recommended original models have been observed in the villages. Instead, the PE-

BGPs are built with emphasis on cost reduction, in many cases featuring lack of quality, which leaves bad reputation due to problems in functionality, reliability and durability. For acceptance of innovations the OFHs' flexibility and creativity are valuable characteristics, but the culture of "spontaneous low cost adoption" to win the market, shows its negative impacts already. The layers of the PE-BGP were reduced, or different, less durable materials used to reduce the costs.

Both BGP-models obviously have their perceived pro and contra and due to the average economic situation of the OFHs, PE-BGP is more likely to be accepted, although the Non-User-OFHs show a slight preference for CC-BGP. This seems to be based on the higher durability (probably due to the unreliability through PE-BGP plagiarism) and disregarding the investment costs. In several cases PE-BGP is perceived as "beginners' model" to test with low cost the BGP impacts. However, low costs as well as low time and workload for installation and emptying procedure are principal determinants of the BGP-model valuation.

Most of the BGPs are financed by credit relying on initiatives from CTU and international organizations (PE-BGP approx. 500,000 VND, CC-BGP 5 million VND) as the economic situation of many OFHs does not allow cash investment; especially if the investment size is higher due to the additional necessity of livestock. Credit interests vary from median 0.3 to 1.0 % per month depending on repayment time and creditor. In case of BGP with the bank as creditor, only credits of production are allocated with a maximum time schedule of 12 months. A special credit program for BGP is not available. It is not necessarily the inefficient poverty outreach but the appropriateness of credit or saving systems taking the OFHs' income amount and its time distribution into account.

With regard to the management of BGP 4-6 fattening pigs or 2 sows plus shoats give sufficient input to run a 10 m<sup>3</sup> BGP. Up to now BGP has been introduced solely on base of piggery. OFHs with big livestock property have been obliged to install a BGP in order to reduce environmental pollution, especially of surface water as well as to avoid air annoyances to neighbors. Others had small piggery and were given the opportunity to make use of the feces in order to have gas and more comfort for cooking, effluent for aquaculture and to facilitate the disposal of feces and garbage to improve their hygienic conditions. And some households even started with piggery to take the advantages of BGP. These OFHs received more or less sufficient information and demonstration on the advantages of BGP-use. But the problem is the unilateral dependency on continuous pig production with the additional constraint of significant fluctuations of their market (pig feed and pig meat).

Further, the OFHs point out their lack of information with emphasis. This information deficit specifically refers to the BGP's attributes, requirements to install, run and maintain as well as advantages (nescience about BGS use) and feasibility calculation. The emptying procedure in case of PE-BGP is frequented low due to the



steady flow of effluent as long as it is run by pig dung (fine, floating material structure). In case of CC-BGP emptying is perceived difficult and uncomfortable. Consequently, BGS is dried in a hole and sometimes mixed with ashes and/or mineral fertilizer before application. A considerable amount of BGP-Non-Users does not have information about the variety of possibilities to run the BGP like to connect their sanitary infrastructure as additional input source. Furthermore, doubts and prejudices that the use of BGP gas smells strong, is dirty or even noxious and that the installation easily burns off, are evident.

The Agricultural Extension Service already tries to offer and transmit information accordingly as well as directly mentioned the necessity of technical assistance. But the institutional structure and efficiency referring on its internal organization, available quantity of field service personnel and its capacity are insufficient. Thus, private contacts/factions seem to be favored as information and demonstration contacts.

In conclusion, the principal determinants are lack of capital and therefore a customized microfinance system, the dependency on piggery and its market instability as well as the lack of monitored construction quality standards. All these points suffer shortcomings in communication including reliable technical assistance and professional training using demonstration units for capacity building as well choices of models for adaptability.

### **Modern Latrines**

The distribution of ML is still very low, decreasing from suburban to rural area. In the rural sites of Long Tuyen and Hoa An about 80 % of the surveyed OFHs have no ML, 10 % no latrine at all. The opinion of some OFHs that ML is uncomfortable or impractical seems to be based on bad experiences with the first governmental initiative to introduce very simple latrines (basic pit latrines) and nescience of the ML attributes. Under cultural aspect, ML-use holds no severe problem, is esteemed as progressive and most of the ML-Non-Users wish to have one in the future. Most common are MLs with septic tank and DVC latrines mainly introduced with subsidies by UNICEF, NGOs or CTU in cooperation with the Health Centre. Costs for ML may range from 450,000 VND to several million VND depending on model, quality/luxury of construction. Less than 7 % of the MLs are financed by credit, although ML-credits allow a longer time of repayment (up to 36 months). Investment in ML is closely linked not only to capital availability but construction of a new house. The OFHs perceive ML as a luxury good that does not fit to their living standard, specifically not to most of the OFHs' dwelling conditions. It is not reasoned by an economic aspect and thus, not worth an independent investment, less by credit or accepted by the social community. The possible relation of saving health care expenses due to improved hygienic and environmental conditions cannot be perceived. The consolidated tradition to use fishpond-latrines predominantly relies on the agro-

economic importance for aquaculture and not on other socio-cultural aspects. Hence, an economic stimulation to motivate people to invest is missing. The household head investing in sophisticated fishpond-latrines to offer service for others in order to use feces to increase his pisciculture is a good example. Apart from the highly appreciated advantages of comfort, privacy, security specifically for elderly and children, hygiene and environment, the immediate economic aspect is vital for acceptance behavior of ML. Furthermore, the OFHs expressed strong doubts referring to the emptying procedure (functionality, service and costs) of the ML tank and sustainable use. About 80 % of both OFH-groups received some kind of demonstration through their direct social environment, but other entities hardly play a role for communication/demonstration of ML.

In conclusion, the principal determinants are lack of capital and credit access, an economic inducement, the ML inappropriateness in relation to the average dwelling as well as people's education and necessity of technical assistance using demonstration units for capacity building. The Health Care Centre and the Agricultural Extension Service should work together on the standardization and general widespread introduction of BGP with connected ML that would also reduce the installation and fix costs.

### **Biogas Sludge**

The NRWSS seeks the improvement of rural hygienic and environmental conditions with the consequence to abolish the use of untreated feces and to reduce applications of mineral fertilizer in agriculture.

The surveyed OFHs use untreated animal and human feces predominantly for aquaculture and fruit growing. Although two thirds of the OFHs do not have any specific reason against BGS-use, estimate it as progressive and are convinced that the plant production improves in quality and quantity by application of BGS, the handling of BGS states a problem and its use provokes considerable rejection. One quarter of the OFHs perceive BGS-use on the basis of human feces compared to animal feces as more critical. Referring to food consumption (fish and vegetable) the doubts show only a slight difference respectively. The present practice to dry and to mix BGS with ashes and/or mineral fertilizer entails a loss of nitrogen content. In case of the floating PE-BGP the effluent/BGS is directly drained into the pond. In case of CC-BGP the emptying procedure is a major prevailing constraint. According to the farmers the alternative to the draining is a change of the BGS consistency to enhance the ease of handling. Therefore, earthworm breeding (EWB) might be an opportunity as acceptance improving practice. The OFHs' knowledge about BGS and even more about EWB is poor in most cases. About half of the OFHs received some kind of demonstration about using organic material mainly by their direct social environment and basic information about EWB but only on TV.

Due to the recent introduction of BGP in most cases and the dominance of PE-BGP, running with a steady material flow, the emptying frequency and thus, the quantity BGS-production is unexpected low featuring no important economic inducement except effluent/BGS for aquaculture. The estimation/calculation of its nutrients content and therefore degree of mineral fertilizer substitution and finally impact depends on the input sources. To make it marketable, this information is essential for the farmers and the quantity needs to be higher in order to justify workload, time and additional storage space. BGS without earthworms can achieve a market price of 1,000 VND/kg, BGS with earthworms 18,000 VND/kg and earthworms alone 180,000 VND/kg. A sales market does exist for high quality material due to the importance of flowers and bonsai trees. The Province Extension Service substitutes 40 % of the initial kilogram of earthworms as start-up. Thus, the combination of BGS and EWB might be a worthy approach.

In conclusion, the main determinants for BGS-use are lack of information, specifically nescience about BGS-use and EWB and in particular the small produced quantity. Its handling is difficult, time-consuming respectively labor loading and space intensive apart from the relatively low market value. Once again, information and technical assistance with demonstration units is needed through the Agricultural Extension Service in a sophisticated way.

### **System-Users' Profile**

Finally, the cross check of the principal results with the System-Users profile has reaffirmed that the holistic approach considering the six dimensions of the OFHs according to LANGENHEDER'S model was necessary. But the social and economic dimension comprises the principal determinants for the OFHs' formation of attitudes leading to acceptance behavior towards the three components of the wastewater management system; although their emphasis varies between BGP, ML and BGS. Consequently, the progress of the diffusion process is hampered principally by low quantity and/or quality of information needed to enable the formation of reliable attitudes towards the innovations. The creation and enhancement of hygienic and ecological awareness in a consistent political setting is conducive and necessary for its sustainability. At the same time, demand-oriented framework conditions (e.g. microfinance systems, technical assistance) have to be provided in order to equalize the OFHs' socio-economic constraints and thus, to facilitate the OFHs' decision-making process.

## **6.2 Recommendations for Sustainable Water and Sanitation Management in Viet Nam**

The first adjacent approach is to establish user societies/groups. It is striking that except one single case, all respondents are investing, installing and using BGP and/or ML on their own. Thus, to avoid the investment risk given by possible lack of

input for the BGP or lack of capital, space, whatever for ML it might a good solution to share investment and usage with others. From the technical point of view no real constraints can be detected. Considering logistic issues and space requirements it would be even an advantage to do so. A couple of families sharing real estate limits would take great advantages in several aspects.

There are various answers found to this justified question. First, the difference in historical and actual settlement of North and South Viet Nam has to be considered. Contrary to North Viet Nam, the Mekong Delta region does not dispose of a traditionally grown settlement characterized by communities with high social capital over generations. Rather, the Mekong Delta features a still very active migration process, people coming from all over the country to look for their fortune in this highly productive and commercial region. Hence, the Mekong Delta misses in many parts a consolidated community structure basing on a conglomeration of extended families, their bridging, bonding and linking capital (MUTZ A. SCHMIDT 2002: 114f)<sup>34</sup>. This demographic, social circumstance seems to make an automatic approach of user communities composed of several OFHs difficult. In the same way this characteristic probably hampers the start-up of small credit-groups and cooperatives by own initiative.

Further, the recent and ongoing transformation process of Doi Moi from a socialist oriented central planning government to a progressive opened and market oriented system has great impact on people's individualization. The overall measures of decentralization, especially the break-up of state-run agricultural production cooperatives and thus, the privatization of land, animals, machines and buildings are a great challenge for people's attitude. The partly forced community thinking of the socialist system turns around in the feeling of property, to live individual objectives and activities ending up in a kind of booming neo-capitalism attitude. Although in the South of Viet Nam collectivization never had been as successful as in the rest of the country. However, the willingness to constitute user communities is supposed to be low due to the taste of former state-run entities.

But, in agricultural production new share-holding cooperatives with individual shares have been developed. In the Mekong Delta until midyear 2000 about 900 "new-style" agricultural cooperatives have been registered (WOLZ 2002: 17ff). Furthermore, due to the survey results on information access, demonstrations and contacted persons for decision-making, the direct social contact of family members, neighbors and friends are estimated with high value. Despite the high migration rate and trends of individualization, social community life continues to be structured by the diversity of

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<sup>34</sup> Ways of using social capital:

1. **linking** - networking across the borders of hierarchy
2. **bonding** - networking with people similar to oneself
3. **bridging** - networking with people different from oneself, but acting in the same social field

unions and clubs and is highly appreciated. So, why should it be impossible to arrange user communities on a smaller level as network for a less chancy infrastructure for sustainable water and sanitation management? Even under the mentioned circumstances it should be tried out/discussed to form groups sharing decentralized water management systems incorporating the mass organizations' platform of social capital or former bonding of pre-Doi Moi cooperatives. The conjoint use of the system reduces investment risk. Even small installation can be shared to take advantage of gas, sludge, effluent and to facilitate feces disposal.

The amplification and efficient organization of the Agricultural Extension Service including a demand-oriented system for microfinance should be seen as the most important key for sustainable rural development.

Thus, it is important to come to a conjoint formation of an operational system for development and introduction of new technology for decentralized water management systems on operating farm household level. Top priority should be given to the composition of the participating representatives. Hereby principally representatives of all mass organizations (including especially the extension officers), the PC, the University, spokesmen of hamlets and quarters as well as may be the potential local providers of the required construction materials (UNICEF 1999: 63).

### **Major points of recommendation:**

↪ **Custom-to-fit-system and information:** Different water management systems for single OFH as well as the approach to use in a group of two OFHs and more have to be developed together and tried out. Clarification of prevailing doubts and prejudices as well as the opportunities to invest in BGP or BGP&ML concerning the principle points as costs, credits, amortization in worst and best case scenario according to animal production and family size require sound communication on an exchange platform for Users and Non-Users. Specifically the ML acceptance misses an economic inducement. Therefore ML-connection to BGP provides an efficient solution with synergy effects as the emptying procedure is superseded, night soil can be reused and in addition the strong dependency of BGP-utilization on piggery is alleviated. For sound communication of these issues a "feasibility-wheel" should be developed (small turntable/slide rule to set the farmer's individual conditions that shows the appropriate model, size, etc.). By means of this tool, detailed information can be disseminated easily by the extension officer and even the farmers themselves can calculate the requirements custom-to-fit before investment. For the elaboration of this tool the seven rules of effective communication materials basing on UNICEF's long-term experience should be taken into account (UNICEF 1999: 48f, 63, 70ff).

↪ **Value and sales market improvement of BGS:** BGS production is very low, the impact difficult to calculate and thus only an asset to mineral fertilizer. Cooperatives or few specialized OFHs collecting BGS for further treatment in order to produce a high quality product by additional EWB achieve a much higher market value. A network of conditions for diversification in agricultural production integrating the hygienic safe recycle of substrates should be build up. A local sales market does exist for high quality material due to the importance of fruit seedling, vegetable, flower and bonsai tree production. In case of vicinity and good infrastructure to access urban markets, the high quality BGS can be a very valuable product for urban agriculture. Another worthy approach might be an opportunity to enable the self-interest of some OFHs by promoting small vegetable gardens close to the dwelling, which have to be flood safe. Up to the present, vegetable house gardens are not common. In case of OFHs with aquaculture the effluent/BGS features its economical importance and is probably the best practice. But the basins with accumulated effluent cause a hygienic threat with regard to vector-transmitted diseases. Thus, the manner of storage should be controlled.

Fact is that BGS requires an improvement of information and thus knowledge about the impact and potential substitution degree of mineral fertilizer basing on further chemical analysis. As in the case of BGP and ML a practical mean of information transmission, based on various communication channels (extension service, direct social interaction, mass organizations, mass media) is needed.

↪ **Communication network for knowledge management:** The established mass organizations, herein especially the Farmer's and Women's Union as well as Culture and Old People's Club, offer an excellent platform for exchange of experience and subsidiarity. Furthermore, the Extension Service requires a restructure in functionality and responsibilities with an operational plan which is monitored. In order to achieve higher quality in consultation and technical assistance according to the principal development issues declared in the national "Comprehensive Poverty Reduction and Growth Strategy" (CPRGS), the Extension Service needs to dispose of more personnel receiving professional training (IMF 2003).

↪ **Capacity building to improve technical assistance:** Professional training of extension officers and responsible contact persons for technical assistance. In this context, demonstration entities should be built up, if possible together with farmers (multipliers), who are open minded and esteemed by their fellow citizens (Bui 2002: 6). This requires the technical and financial support of the CTU and GoV institutions on all levels. The entities serve as information pools and training installations. Importance should be put on adequate solving measures/strategies

of occurring utilization problems to create independency in management and maintenance of BGP and connected ML.

- ↪ **Service network for microfinance at grassroots level:** Apart from the variety of BGP and ML models and sizes with different prices, an effective introduction and dissemination incorporating the economically fragile households (poverty outreach) requires a service network for microfinance at the grassroots level. This network has to fit to the household's needs (demand-oriented) as well as to the regional socio-economic environment and national policies on rural development considering macroeconomic aspects on financial institutions (financial sustainability). Therefore it might be appropriate to establish a diversified network for microfinance composed of the bank (VBARD/SPB), credit cooperatives, village credit stations (located in the People's Committee), saving associations (with support of the according mass organizations) and other informal credit/saving groups (LING, ZHONGYI ET AL. 2002: 352ff). These entities, formal and informal, credit and saving mobilizations should have the possibility to interact for achievement of more flexibility in their offers and thus, improved demand orientation. Secondly, the microfinance institutions need to elaborate a credit system in a construction-kit-style, which means that each step (e.g. investment and use of BGP) can be independent and sustainably conductible, but also easily extended by an additional system piece (e.g. investment and use of ML).
- ↪ **Stabilization of agricultural production:** Of course it is difficult to reduce the market price fluctuations for agricultural products, especially for piggery in a liberal market system. Prevention of usury and introduction of quality standards concerning means of production (e.g. mineral fertilizer, rice bran, broken rice, etc.) would be a first step. Furthermore, communication, professional education and assistance may help to rationalize the expectancies so that the OFHs anticipate more realistically in the long-term value without falling into the trap of short-term price increase. Also the development of agricultural marketing associations may be a promising approach for stabilization.
- ↪ **Introduction of quality standards:** The Vietnamese flexibility and creativity are valuable characteristics but the culture of "spontaneous low cost adoption" to win the market showed its negative impacts on BGP and ML acceptance and dissemination. Elaboration of standardized construction packages for concrete and polyethylene BGP as well as ML are necessary. These systems have to be flexible according to size and location and obtain the opportunity of successive extension. But the way of construction and especially the used material has to be standardized to achieve more reliability for investment. In this context it might also be enhancing to qualify interested persons in the construction of these installations. Furthermore, the realization requires official, cross-border

regulations controlled by a monitoring unit (Extension Service) to avoid plagiarism and to assure a progressive process on the long-term.

↳ **Monitoring unit:** By means of the existing Extension Service it is important to attend the process in the long-term. It offers the possibility to react on the change of conditions, progress of research and to adjust the system institutionally. This monitoring unit needs a participatory approach to be reliable and efficient. Thus, representatives of each institution, organization and target group should be integrated to form a committee respectively.

These recommendations are made on the basis of the survey results from the point of view of economic sociology; one of the six research groups of the interdisciplinary project "SANSED". Additionally, the recommendations of the other work-groups of the SANSED Project should be taken into account. Then of course, they should be discussed on a pilot workshop together with all responsible persons and consequently elaborated in detail according to the national and local framework. As the GoV aims strong dissemination of sanitary infrastructure including biogas technology, the results and experiences may contribute to the national policies and strategies in the water and sanitation sector (NRWSS).

In line with the preceding recommendations for future operational activities, it is important to mention that further research work is needed for studies of the OFHs' acceptance behavior and dissemination process while and after implementing the mentioned recommendations and tools. Principal research task is to find the most successful way to reach the "Early and Late Majority" of OFHs. Thus, in the course of SANSED II as well as for other projects concerning water and sanitation issues, the research on efficient information strategies including the organization of the institutional network specifically on community level, appropriate information material and demonstration units should be given highest priority. Herein, the development of the agricultural extension service and the microfinance service with emphasis on its appropriateness for each single innovation should be core issues of research efforts by means of accompanying studies.

In order to bring forward the aspect of nutrient recycling in the scope of wastewater management/ecological sanitation, the approximate calculation of nutrient content and impact of organic fertilizer (BGS) feasible by the farmer himself, as well as the most efficient way of application are still tasks for research surveys.

Last but not least, this knowledge progress and capacity building might improve the OFHs' acceptance rate.



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**Appendix**



**A: Water Market, Can Tho**



**B: Floating Store**

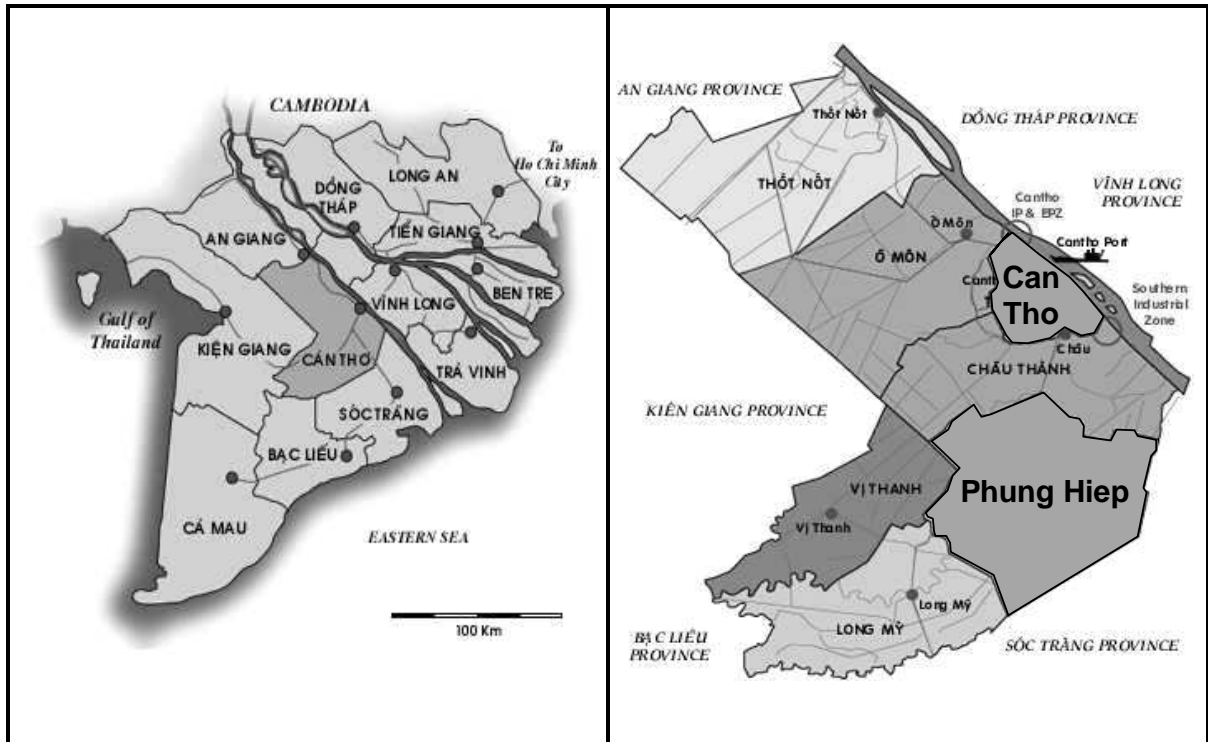


**C: Small-Scale Salesmen**



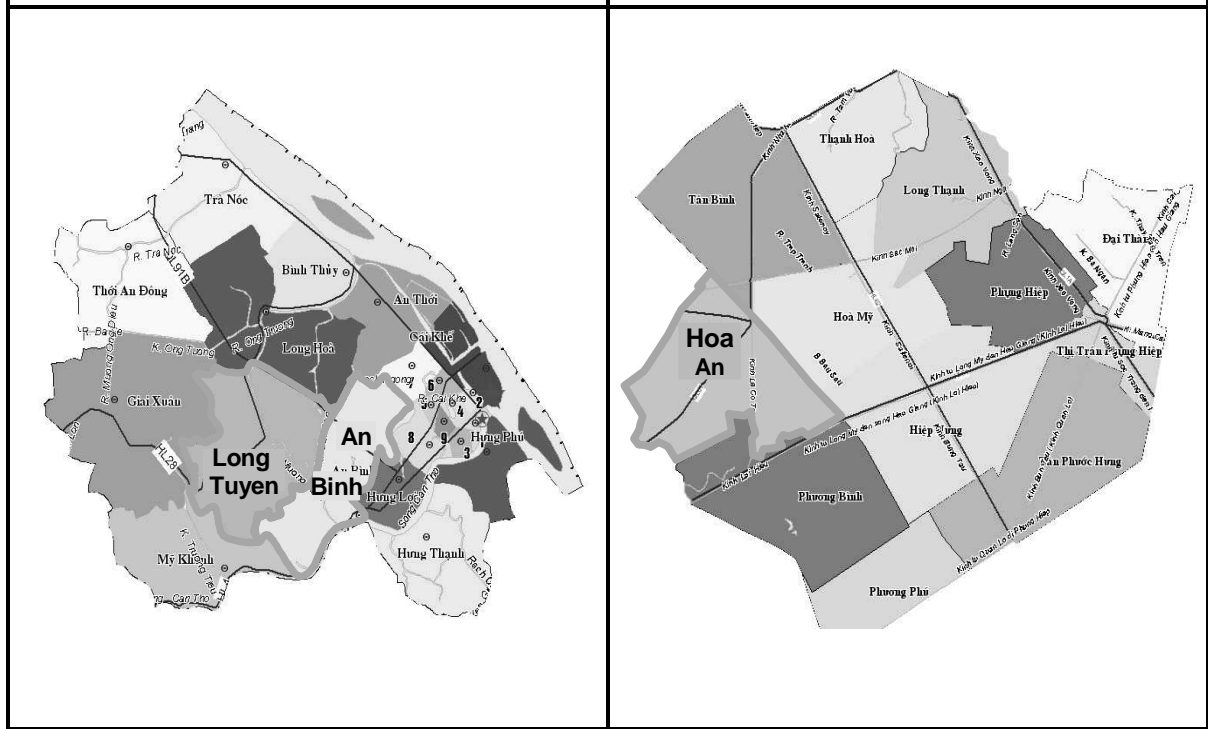
**D: Rice Transport For Jail Supply**

**Appendix 2-1 : Can Tho Water Networks for Transportation**



**A: Mekong Delta with Province Can Tho**

**B: Province Can Tho, Districts**



**C: Long Tuyen and An Binh in the District Can Tho**

**D: Hoa An in the District Phung Hiep**

**Appendix 2-2: Maps for Localization of Research Sites**





**A: PE-BGP**



**B: CC-BGP in Construction**



**C: Biogas-Globe in Pigsty**



**D: Biogas-Kitchen-Stove**

**Appendix 3-1: Different Types of BGP-Installations**



**A: Fishpond-Latrine**



**B: Conjointly used Fishpond**



**C: Sophisticated Brick Fishpond-Latrine including Electric Illumination**



**D: Modern Latrine (septic or DVC)**

**Appendix 3-2: Typical Latrines Used in the Research Sites**



**A: Monkey Bridge**



**B: Cycle/Pedestrian Bridge**

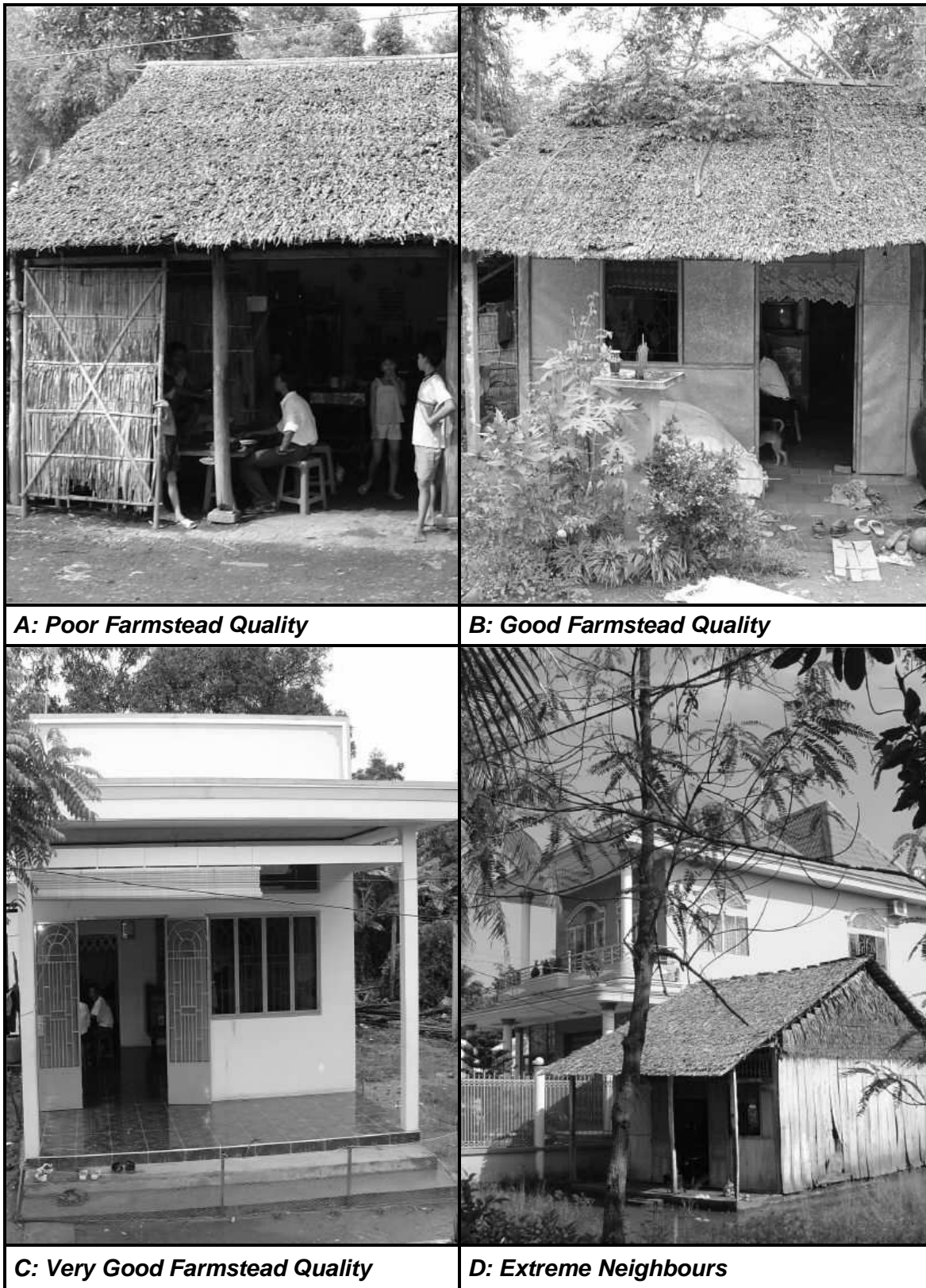


**C: Concrete Bridge Above Canal**



**D: Modern Concrete-Steel Bridge**

**Appendix 5-1: Major Categories of Bridges**



### Appendix 5-2: Examples of Farmstead Quality

The farmstead quality depends on the used construction material of the (1) roof, (2) wall and (3) floor. - **very good**: (1) metal/tiles, (2) bricks/concrete, (3) flagstones; **good**: other combination; **poor**: (1) leaves, (2) bamboo/wood, (3) soil



**A: Inadequate Rainwater Collection in Open Jars**



**B: Improved Rainwater Collection in Covered Jars**

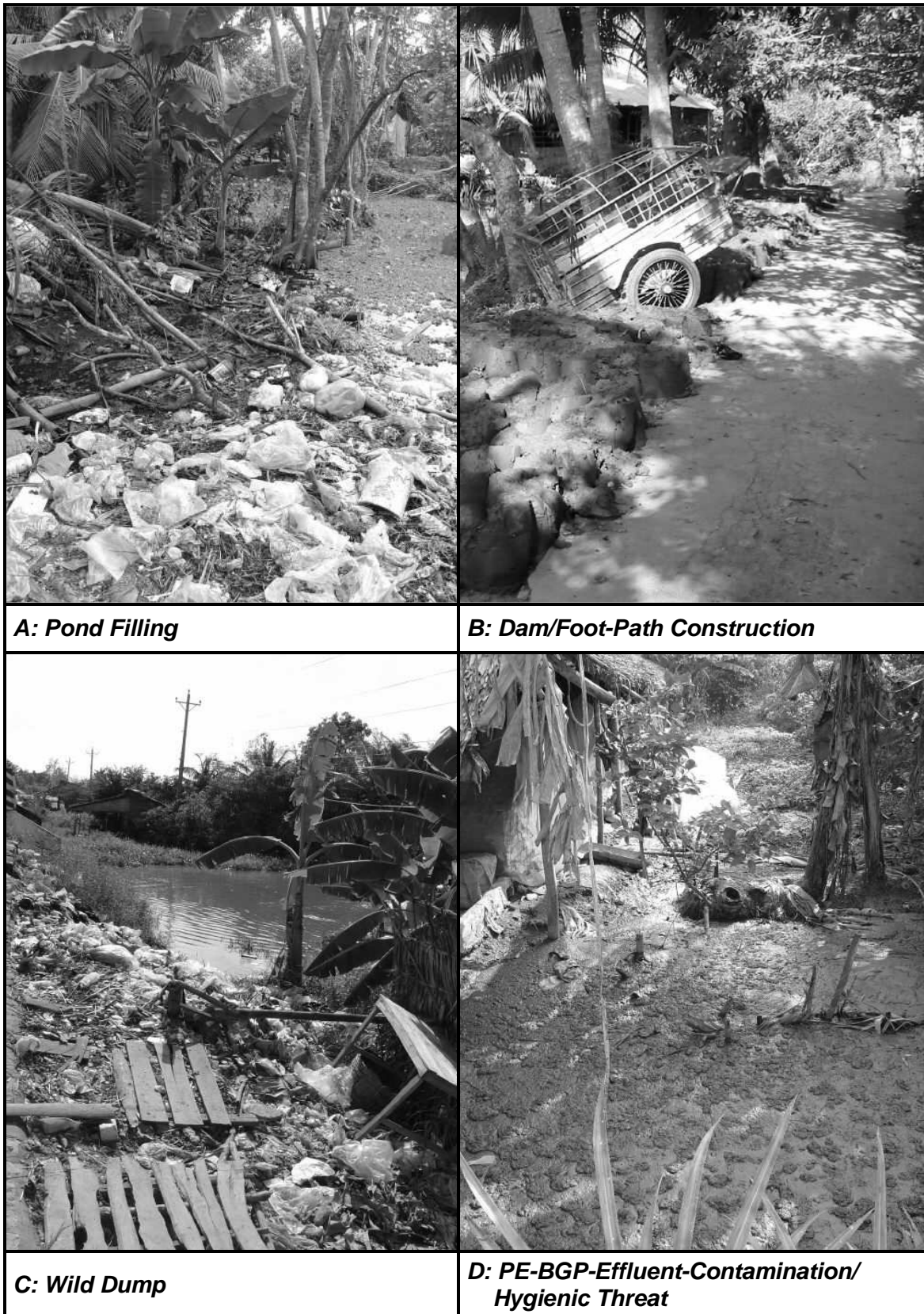


**C: Pipe Construction for Rainwater Collection**



**D: Sophisticated Rainwater Collection in Special Water Storage Tank**

**Appendix 5-3: Rainwater Collection**



**Appendix 5-4: Garbage-Pond-Filling, Wild Dumps and  
PE-BGP-Effluent Contamination**



**A: BGS-Pond**



**B: BGS/Ashes-Mixture**



**C: Fruit Tree with Applied Organic Material**



**D: Earthworm Breeding**

**Appendix 5-5: BGS Treatment and Application**