A Study of the Practice of Well Irrigation in the Country around Vavuniya in Northern Sri Lanka

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Introduction

Vavuniya[1] is located in the North Central Dry Zone of Sri Lanka, where the two major ethnic groups of the Island the *Sinhalese* and the *Tamils* meet geographically (Fig. 1). Historically, this area formed part of the ancient province of Nuwarakalawiya[2] where a hydraulic civilization once flourished (Brohier - 1934; Leach - 1959). The traditional system of agriculture based on village irrigation reservoirs combined with *chena cultivation* constituted the mainstay of life for both *Rajarata Sinhalese* and the *Vanniar Tamil* peasantry. Over the centuries of land occupance, a three-fold landuse pattern comprised of the *wewa* (the irrigation reservoir) the *wela* (the rice field) and the *gangoda* (homestead garden) was evolved. In the forest tract surrounding the nucleated village settlement, *chena cultivation* (or shifting cultivation) is practised during the wet season. This landuse system was found to be spatially well organized (Tennakoon, 1974, see Fig. 2) and the sequence of agricultural activities over the year was observed to be finely harmonized (Panabokke, 1959). The low population density, kinship and social cohesion in the villages combined with Buddhist or Hindu culture symbolised by the religious monuments often found on the inselbergs of the Dry Zone landscape, provided an ecologically and socially stable human organization (Leach, 1961). Inspite of the arrival of peasant colonization schemes (Farmer, 1957) such as Ullukkulama and Iratperiyakulama, and the increase of rural population during recent times, the basic structure of the *purana* (traditional) village system in the Vavuniya country appears to have remained more or less intact. However, the increase in population without a commensurate rise of real incomes,

1. The data presented in this paper relate to the Vavuniya South Sinhalese and Tamil Revenue Division of the District.
2. Nuwarakalawiya according to the folklore is that part of the Island where the three giant irrigation reservoirs of *Nuwara* Wewa *Kala* Wewa and *Padaviya* are situated. An irrigation civilization flourished in this area during the period 5th Century BC to about 10th Century AD.

found expression in widespread poverty and youth unemployment which contributed in no small way to the social unrest and upheavals in the early part of this decade. It had thus become imperative to explore avenues of employment for the increasing unemployed youth and to increase the general levels of income in these rural areas through an increase in the productivity of lands both used and unused. The open-well ground water irrigation which began to spread during the last two decades, inspite of the lack of any effective and adequate governmental support, appears to have served at least in a small way to ameliorate the life in the villages where it is actually practised.

Nature of the Present Survey

In view of the numerous attempts made to study the environmental aspects of ground water use in the recent past (Farmer, 1956, Madduma Bandara, 1973 and 1977, Fernando, 1973, British ODM Team, 1976), the present survey was undertaken with a different intention which was geared towards achieving three broad objectives, namely: (a) to monitor the developments taking place in the agricultural practices based on well irrigation in the area; (b) to understand the farmers' attitudes and perceptions regarding the practice of well irrigation, and finally (c) to explore and plan for the paths along which possible future developments should take place. The present paper reports and analyses some results of the survey relating to the first two objectives.

During the field survey particular attention was paid to ascertain the nature of a few important issues. These included:

(i) the degree of risk involved in the excavation of wells in the hard rock areas (ii) the capability of the well irrigation practice for employment generation and (iii) farmers' perceptions on well irrigation as an economically feasible venture. Since the answers to most of these questions cannot be mutually exclusive, no attempt has been made to deal with them separately.

The field survey was conducted during the middle of the dry season (i.e. June to August) of 1977. A total of 361 farmers was interviewed with the aid of a predesigned and pilot-tested questionnaire and their responses were recorded in the field. In the absence of any comprehensive understanding of the total population of farmers practising well irrigation, extraction of a representative random sample proved rather abortive. Therefore, the present sample of 361 farmers was selected partly with the aid of records kept at government offices and partly from the information gathered while trekking from village to village.[3] However, this shortcoming in the survey is recognized as statistically serious. One Sinhalese village (i.e. Kokveliya, located about 5 km. to the north of Vavuniya town) where there were some 42 food production wells[4] was excluded from the sample in view of the fact that it was selected as a model village for development by the Freedom from Hunger Campaign Project of which this survey formed an integral part.

The interviews were conducted by two Tamil speaking and two Sinhalese speaking investigators all of whom were graduates who read either Geography or Economics or both at the University. Much of the technical information pertaining to the wells (such as geological, hydrological and constructional details) were obtained directly by the investigators who had some training in handling the simple field equipment involved. The work of investigators was subjected to constant checking and supervision in the field.

The Environmental Setting

The country around Vavuniya falls within the area generally referred to as the 'Dry Zone' which covers nearly 2/3 of the total land area of the Republic of Sri Lanka (see Fig. 1). The use of the term "Dry Zone" to describe an area which receives a mean annual rainfall exceeding 1250 mm was not without controversy. Nevertheless, for a variety of reasons, the use of the term "Dry Zone" had come to stay in the geographical literature on Sri Lanka. The fact that the "Dry Zone" is a reality cannot be gainsaid in view of the marked seasonality of rainfall and the conditions of water availability (Sirinanda, 1975). Thus Vavuniya which forms part of the northern segment of the Dry Zone of Sri Lanka receives nearly 70% of its total annual rainfall of some 1400mm. during a short rainy season extending from October to January, leaving the greater part of the year dry except in April when a small but agriculturally significant amount of rain is received from convectional thunderstorms. Apart from the high seasonality of rainfall, the intense solar radiation combined with strong dry winds

3. According to some officical claims there were 3000 food production wells in the Vavuniya District in 1976. If these figures are dependable, the present sample represents approximately 15% of the total number of farmers practising well irrigation It should be noted that farmers practising well irrigation form only a small minority of the total number of farmers in the area. The great majority of farmers in Vavuniya, particularly the Sinhalese farmers still depend entirely on the traditional agriculture based on village irrigation tanks and *chena* cultivation.

4. The term food production well was used by the government functionaries to describe those wells which were constructed through governmental support for the purpose of irrigating food crops.

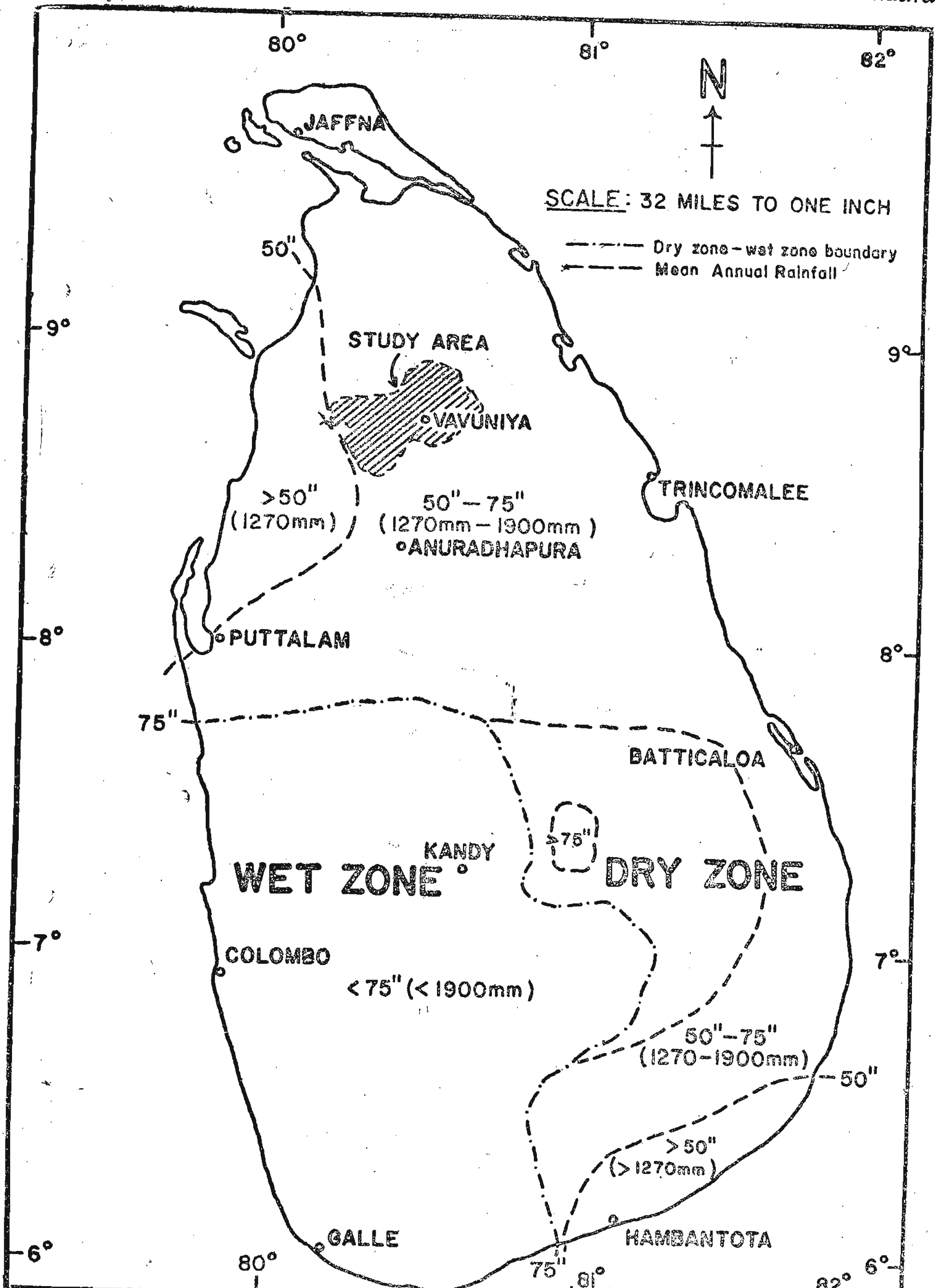

Figure 1: Map of Sri Lanka Showing the Location of the Study Area.

(locally named *Kachchan* or *Wesak hulan*) during the dry season leads to high evapotranspiration rates which make even the small amount of rain that does actually fall often ineffective.

Thus Sirinanda (1975) estimated the annual water deficit in the country around Vavuniya to be in the region of some 500 mm. The prolonged drought conditions are a common occurrence in Vavuniya as in other parts of the Dry Zone (Farmer, 1956; Alles and Amarasoma, 1968). As in the ancient past, the shortage of water still remains a major constraint to agricultural development in this area.

Apart from the narrow limestone areas confined to the Northern and North Western coastal areas where several groundwater development projects are in progress (see Agroskills, 1976), the rest of the Island of Sri Lanka (nearly 90%) is floored by ancient crystalline rocks of the Precambrian age. The country around Vavuniya falls within this group of crystalline rocks which have relatively poor water bearing properties. The poor aquifer characteristics of these basement rocks often put off the civil servants during the first half of this century, who hesitated to direct any governmental efforts to develop whatever groundwater resources were available in the Dry Zone. Geomorphologically, the area around Vavuniya, although superficially a plain, is diversified by rocky ridges (as Madukanda) isolated hills (as at Erupotana) and less obviously by low divides locally named as *hinnas*. The hypothetical cross-sectional diagram in Fig. 3 summarises most of these terrain characteristics (Farmer B. H, 1954). The water table in these areas is highly sensitive to rainfall and fluctuates seasonally (Madduma Bandara, 1977b).

The vegetation in the area around Vavuniya is basically a deciduous dry zone tropical forest type. Although much of the natural vegetation is now modified by agricultural activities, large tracts of forest lands are still a common sight.

As early as 1956, Farmer demonstrated the lessons the Dry Zone farmer in Sri Lanka could learn from the farmers in South India who practised lift irrigation on a wider scale. More recently, the writer (Madduma Bandara, 1977a) could argue that the potential for development of available ground water resources in the Dry Zone cannot be assessed or prejudged entirely on the basis of the hard nature of the crystalline rocks. On the environmental side the existence of irrigation reservoirs, the vast expanses of irrigated rice fields, the 'highland-lowland' nature of the terrain and the catenary sequence of soils are among the many factors that have to be taken into consideration if one is to arrive at a more realistic

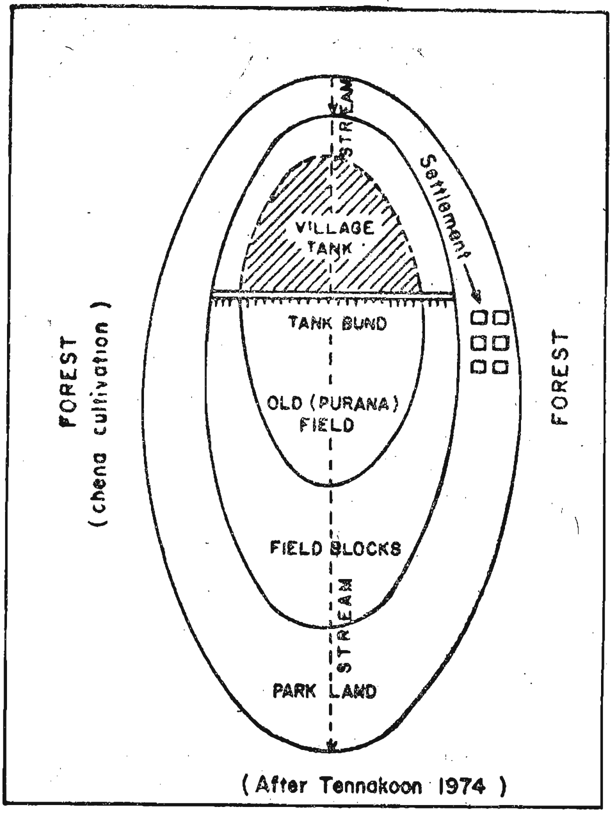

Fig. 2: An Idealized Representation of Spatial Organization of Agriculture in a Purana (Traditional) Village.
(Irrigation wells are mostly located in the Parkland zone)

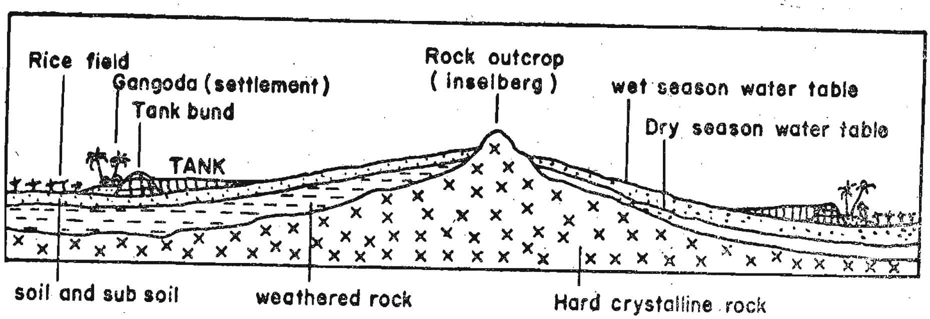

Fig. 3: A Diagramatic Cross-Section of the Dry Zone Catena.

estimate of the potential for development of ground water resources. It is equally important to recognize the importance of recent developments such as the upward trend in the market prices of agricultural commodities such as *chillies* and *onions* which can affect the cost-benefit ratios in a significant way. Apart from the environmental and economic issues, the attitudes and perceptions of the farmers who are in fact the final decision-makers should also be given due consideration. It had been argued that any assessment which fell short of recognizing this whole gamut of factors is bound to be superficial and unrealistic.

Wells: their history, location, physical and constructional characteristics

The practice of using wells for irrigation of subsidiary food crops existed among Tamil farmers in Vavuniya even before the time of national Independence in 1948. Thus it was found that nearly 5% of the wells in the sample were excavated before 1948. However, as Fig 4 indicates the excavation of wells on a much wider scale commenced only after 1956. There was a peak of well digging activities in the 1957/58 period during which some 14% of the wells in the sample were opened.[5] However, the largest number of wells in the sample were opened only after 1974. Some 23% of the wells in the sample were excavated between the beginning of 1974 and the time of the survey in mid 1977. It was also during this period that the practice of well irrigation began to spread into Sinhalese and Muslim villages.

Several factors were responsible for the rapid spread of well irrigation in the three year period from 1974 - 1977. Firstly, the unusual drought which prevailed during the early seventies compelled many farmers to explore the possibilities of groundwater irrigation. It was also during this time, that the prices of some agricultural food commodities such as *chillies* and *onions* began to soar up to unprecedented levels. The price of *chillies* for example shot up from around Rs. 5/- per pound to something like Rs. 35/- per pound within a period as short as three to four months. The government which often had to spend a substantial amount of money on drought relief, also became more receptive to the idea of groundwater

5. It is difficult to isolate the reasons for the escalation of well digging activities during this particular period. The large number of droughts and dry spells which occured in 1956 (199 days) and 1957 (201 days) have obviously compelled the farmers to dig more wells. Apart from this, the fears created in the minds of Tamil farmers at the dawn of Bandaranaike era in the political history of the Island would have been manifested in the unprecedented rate of well digging activities aimed at consolidating their land holdings.

6. Political Authority represented the apex of district administration at that time.

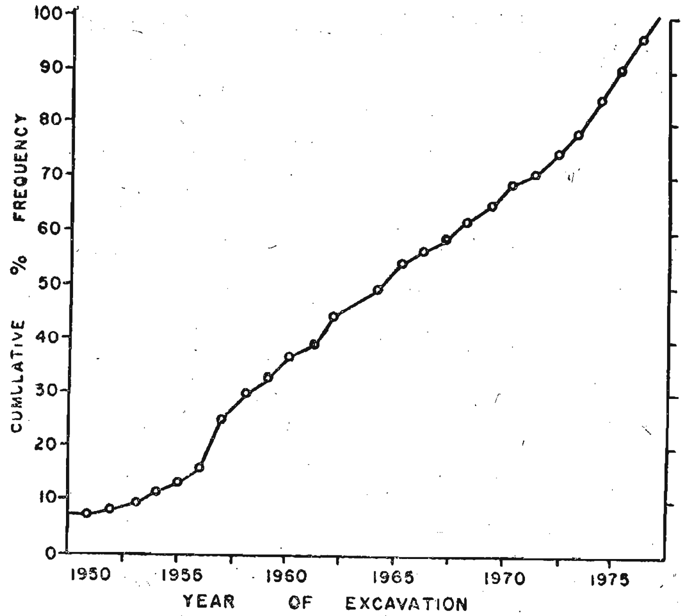

Fig 4 The History of Well Excavation in Vavuniya.

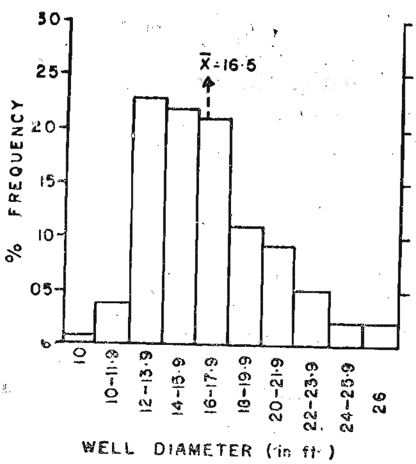

Fig 5 Distribution of Well Diameters.

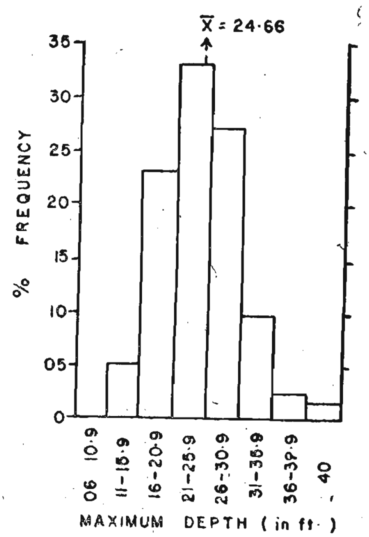

Fig 6 Distribution of the Maximum Depth of Wells.

irrigation and began to provide assistance in a small way to farmers through Political Authorities[6] to open up what was then called 'food production wells'. The food crisis in the country brought enough pressure on the Government to assist the farmers to open wells to irrigate at least a few food crops even on a very small scale. The decentralized budgetting which was introduced in the early seventies made it possible for each district to handle its own development programmes, although the response to the 'food production drive' was different in different Dry Zone districts. In this connection, the Government Agent of Vavuniya at that time deserves special credit for his relentless efforts to develop well irrigation.[7] Apart from these attempts, the initiative of some rich farmers in Vavuniya[8] in the field of well irrigation undoubtedly had a demonstrative effect on other farmers in the area. Well irrigation being basically a Tamilian technology, it was the Tamil farmer who assumed the role of the innovator and the spread of wells generally appears to approximate the rising segment of the usual 's' curve of innovation diffusion, indicating that well irrigation was still spreading fast at the time of the survey. (See Fig. 4).

Location of the Wells

Nearly 96% of the wells belonging to the farmers in the survey sample were located in what is considered as 'highland' in the villages. Although the term 'highland' in general refers to the land that cannot be irrigated by the village irrigation tank, it often includes several landuse categories. It may include the homestead garden of the farmer, a plot of land given to the farmer under the village expansion scheme where the farmer is still not resident, or the *chena* land where the farmer has put up a temporary shed with the intention of making it his permanent abode in the future. Of these categories, the commonest type of land where the wells were found was the land given to the farmers under Land Development Ordinance as part of village expansion programmes or similar arrangements. These are often square or rectangular blocks of land separated by straight pathways drawn on Block Out Plans with little relevance to soil or groundwater conditions. Thus as at Samalankulam, many homestead gardens have bare rock exposures, or extremely thin soil horizons.

The remaining 4% of wells in the sample were located in *paddy* lands owned mostly by rich farmers who bought them from poorer ones in the *Purana* villages. However, most of such lands are not *purana* fields but

7. The Government Agent of Vavuniya at that time was nick-named' the great well digger' by many government officers.

8. An example is one such farmer who claimed that he owns some 35 irrigation wells, and who happened to be the owner of several agro-business establishments in Vavuniya.

was slightly smaller than the top diameter which represented a method adopted by the farmers to make the walls of the wells more stable especially during the rainy season.

In some 51% of the wells in the sample crystalline bedrock (granitic or gneissic) was encountered while digging. The remaining 49% was reported to be dug into the weathered or 'brittle' rocks. Of the wells reported as located on the weathered rocks, large rock fragments or rounded boulders were seen in 23%. The depth at which the bedrock was encountered varied from 2 to 10 metres. Table 1 shows the percentage of wells encountering the bedrock at given depths. This shows that in many wells the bedrock was encountered at depths between 3·5 and 7·0 metres, This indicated that in the 'highland' areas where 96% of the survey wells were located, nearly 50% of the wells will hit the bedrock at depths of less than 10 metres.

TABLE 1

Depth of bedrock from surface		Percentage of wells
m	ft	
2·4	08	00·05
3·0	10	03·00
3·6	12	10·80
4·3	14	19·10
4·9	16	26·00
5·5	18	32·10
6·1	20	37·90
6·7	22	44·30
7·3	24	46·60
7·9	26	48 40
8·5	28	49·50
9·1	30	49·80
15·2	50	50·40

Among other things, Table 1 shows that one can be highly confident that the bedrock will not be encountered in the highlands until a depth of 3 metres from the surface is reached. However, the probability of encountering the bedrock increases rapidly within the next 3 meters. At a depth of 8 metres from the surface, the chances of hitting the bedrock becomes fifty-percent.

In general, the field observations indicate that bedrock-bottomed wells are located closer to the divides than to the lowlands. An average vertical section of a well wall shows a soil profile (A and B) up to a maximum depth of 2 metres and then a gravel layer at a depth of 2 – 3 metres. Below this a weathered rock layer is seen between 3 and 5 metres which often contains large rock fragments and rounded boulders. The weathered layer extends up to the crystalline bedrock the depth of which varies according to the thickness of the regolith above it.

It appears from the above discussion that only half the wells in the sample had rock bottoms and the maximum depth of the wells varied between 3–15 meters. On the basis of these two facts, one can argue that bedrock was not encountered in many wells because they were very shallow. However, a comparison of the depths of bedrock wells with the depths of those dug into the weathered rocks does not support such a view.

In the excavation of wells, encountering the bedrock at shallow depths has serious hydrological and economic implications. According to the survey some 69 wells (19% of the sample) were reported as 'running dry' during the height of the dry season. About 60% of these seasonal wells were dug into the hard bedrock. Any attempt to deepen these wells by blasting the rock is not only costly but can also often prove to be a futile exercise. Nevertheless, the wells that run dry during the dry season cannot be written off as total failures. Nearly 40% of these seasonal wells were in the weathered rocks and they could be deepened without much cost to obtain more water. Apart from this, out of these 69 wells, only in 6, was the adoption of some method of augmenting the supplies observed. This suggests that there is much scope for improving the water supplies of these seasonal wells. However, even if their supplies are augmented by various methods, it is difficult to expect many wells to have enough water to make any cultivation possible during the height of the dry season. On the other hand, if they can provide enough water for animals and domestic use when other sources of water become scarce, in addition to their role as supplemental wells during the wet season when any failure of rains can destroy a crop, they can prove to be economically productive and highly beneficial to the rural communities.

The farmers who made some attempts to augment the supplies of their rock-bottomed wells were observed to have adopted several methods. These devices included the drilling of bore holes at the bottom of the well, digging a small well at the bottom of the main well and the excavation of horizontal extension galleries. Nearly 20% of the farmers in the sample mentioned the adoption of one or more of these supply augmentation techniques. The most popular method of them all was the drilling of bottom bore holes. Usually, the drilling was done manually by skilled labour gangs who moved from village to village with their locally fabricated equipment. Being a hard and a skilled job the charges of the workmen were 3–4 times higher than the daily wage paid for other agricultural labourers. Most farmers who used the bore hole method reported that it did significantly increase the volume of water in their wells. However, apart from the cost, the drill gangs were few and difficult to trace when there was a real need. This appears to be an area where the concepts of intermediate technology could be successfully applied.

When the farmers were asked about the rate of recovery of their wells when they are occasionally emptied for purposes of cleaning, nearly 75% of them reported that the normal water level is regained within 3 days. Some 47% of them reported that it occurs within 24 hours.

There were not many complaints regarding the quality of water in the wells. Some 71% of the respondents reported that the water is fresh and good while only 14% reported that it is slightly brackish. Another 14% reported that the water leaves a thick residue in their kettles and a few (1%) people reported that rice turns into a pink colour when it is boiled in well water. There were hardly any complaints regarding the use of well water for irrigation. Some farmers actually mentioned that their crops thrive better on well water.

The total cost of constructing wells generally ranged between Rs. 1000 and Rs. 12,000. The cost was largely determined by the size and depth of the well as on the depth of rock blasting where it became necessary. The sample also included some 9% of the farmers whose wells remained unlined up to the time of the survey. The cost also varied according to the year of construction, the depth of concrete casing, the amount of family labour input and a host of other minor factors. Although the cost of constructing the wells varied widely, nearly 75% of the wells were constructed at a cost of less than Rs. 6000 and some 51% of the wells came within the cost bracket of Rs. 2000 – 5000 (Fig. 7).

There were two sources of funds for excavating and constructing wells. About 48% of the farmers reported that they received governmental support, while a similar proportion (46%) reported that they used their private savings. There was a smaller category of farmers (5%) who mentioned that they used only family labour for excavation. It was surprising that only one farmer reported that he obtained a private loan to construct the well.

Water Pumps and other Water Lifting Mechanisms

As already mentioned, the lift irrigation practice in Vavuniya was first started by the Tamil farmers who brought with them the traditional water lifting technologies of Jaffna and South India, where some of these methods such as *Kamalai* and *Thula* were in use for centuries (Madduma

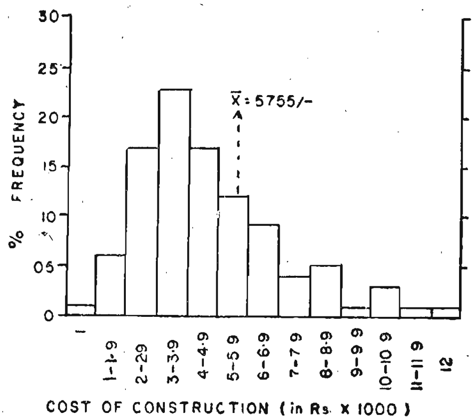

Fig. 7 Reported Total Cost of Well Construction in Vavuniya.

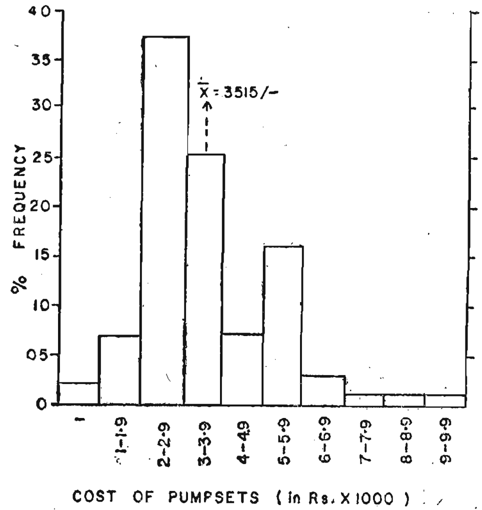

Fig. 8 Reported Costs of Pumpsets.

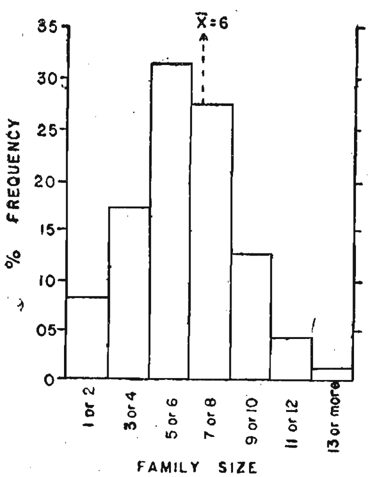

Fig. 9 : Family Size of Farmers Practising Well Irrigation.

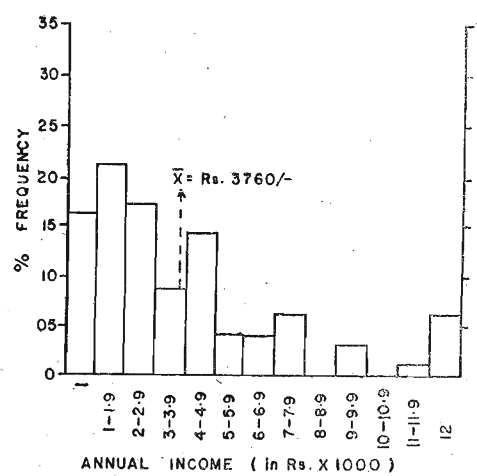

Fig. 10 : Annual Income from Crops Grown Under Well Irrigation.

Bandara, 1977). However, the introduction of the oil powered pumpset was a recent development which became extremely popular during the last decade.

The survey reveals that 88% of the farmers in the sample owned some mechanical device to lift water from the wells for irrigation purposes. Of this number, 61% had oil pumpsets, 22% had *kamalai* and 4% reported that they use *thula*. A small number of farmers (1%) used both *kamalai* and *thula*. During the field survey, it was observed that even some Sinhalese farmers have started using a modified version of *thula*. In general *thula* and *kamalai* were used by relatively poor farmers who could not afford to buy the pumpsets. On the otherhand, the pumpset had become a sign of affluence and a symbol of prosperity. Some 94% of the pumpsets in use were bought by farmers after 1967, and were generally regarded as new by farmers. In fact, nearly 73% of the pumpsets were found to be less than 5 years old. It was also found that some 89% of the pumpsets were bought new while only a very small proportion (11%) were bought second-hand.

The brand of pumpsets varied widely and at least 7 names were mentioned by the farmers. These included Wolsley, Villiers, Ceygma, Centric, Robin, Banda and Minsi. However, the most popular ones were Indian Villiers (40%) and English Wolsleys (28%). At the time of the survey, Japanese pumps such as Robin were gaining ground fast. Almost all the pumps used (99%) were 2" in diameter, and the great majority of them (72%) had 3·2 h.p. engines. However, there was a small but significant number of pumps (13%) with engines of 4·0 h.p. capacity. Almost all the pumpsets used kerosene as fuel. The great majority of pumpsets (76%) had a capacity to pump 7000 - 9000 gallons of water per hour. The two most popular pumps - the Wolsleys and the Villiers, came within this range.

The great majority (96%) of farmers in the sample reported that the performance of their pumpsets was good, and only a small minority (4%) had complaints. This is not surprising in view of fact that a large proportion of pumpsets were bought new during the 1972 - 75 period. Most complaints, as could be expected, came from the farmers who owned second hand pumpsets. The price of pumpsets varied between Rs. 1000 and Rs. 10,000 depending on their diameter, power, brand and of course on the year of purchase. The price of the great majority of pumpsets (64%)

9· The figures indicate the costs incurred by the farmers during the time of constructing the wells. Therefore they do not necessarily indicate the present costs.

ranged between Rs. 2000 and Rs. 4000. The relatively high frequency of pumpsets in the price category of Rs. 5000 to Rs. 6000 actually indicates the price of new Wolsley pumpsets at the time. *(See Fig. 8).*

There was an important minority of farmers (11%) who hired pumpsets from richer farmers when they became absolutely necessary. The charges were based mostly on the number of hours used and the usual rates were either Rs. 5 or Rs. 10 per hour, without fuel. There was an isolated case where a farmer hired a pumpset on a monthly basis for Rs. 250 per month.

It was an equally common practice to hire *kamalai* on a daily paid basis. The hiring charges for *kamalai* ranged from Rs. 25 to Rs.35 per day. The hiring of *thula* was reported only by a small group of farmers (5%) and the hiring charges did not usually exceed Rs. 15 per day. The hiring of these traditional lift devices had often become necessary due to the difficulties of obtaining pumpsets at needy times. However, the use of these methods provided more employment to the rural poor and an opportunity for the farmer to make use of the idling bullocks during the dry season. On the other hand, mechanical as well as economic efficiency of the traditional lift devices appears to be rather poor. Assuming that a *kamalai* hired for Rs. 30 per day would lift 2000 gallons in a day, and a pumpset hired for Rs. 15 per hour (with fuel cost added) would lift 1000 gallons in 2 hours, the cost of a unit of water lifted by *kamalai* would at least be five times higher than that of using a hired pumpset. In this connection it should be mentioned that most wells do not store more than 10,000 gallons of water at the beginnig of the dry season and the recuperation rates are not high in the hard rocks. Therefore, it may be argued that, although, the use of *kamalai* is more expensive in terms of the cost of a unit of water lifted, in certain ways it is better suited to the ecological and human conditions of the area.

The Irrigated Lands: Their Physical and Tenurial Characteristics

As noted earlier, the great majority of wells in the sample were located in what is commonly considered as 'highlands'. The survey reveals that a large proportion (68%) of these highland blocks were lands granted to farmers by the government under the provisions of the Land Development Ordinance on the usual 99 year lease. Nevertheless, 26% of the farmers in the sample were owner cultivators and there was a small minority (6%) of tenant cultivators who hired the land with the well for specific periods. In the case of hired lands, land rents varied between Rs. 100 and Rs. 500 per acre, while the largest proportion came within the category of Rs. 100 to Rs. 300 (67%). As will be mentioned later, it is interesting to note that many of these tenant farmers thought that their investment on well irrigation was not worthwhile.

A wide variation in the size of land owned by individual farmers was also observed. This ranged from less than 1 acre to over 35 acres. However, the bigger farmers who owned above 10 acres were only a small minority (04%). It was the small farmers with holdings of less than 4 acres who constituted the bulk of the sample (70%). The relatively prominent frequency of farmers (14%) who owned 5 - 6 acres land indicate the groups of retired junior government servants who received larger blocks of lands in the 1950s, as at Samalankulam.

The great majority of farmers in the sample (96%) reported that they had no paddy lands. Therefore, it is logical that they had to make the best use of the only parcel of high land they owned. This had undoubtedly compelled many farmers to excavate wells and start lift irrigation to increase the productivity of their highlands. These farmers who resorted to the practice of lift irrigation actually formed a 'landless class' in the eyes of the traditional *purana* villagers since they do not own any paddy lands. The important fact here is that farming based on well irrigation is effectively providing a livelihood to those farmers who would otherwise have had no choice but to become a class of truly landless agricultural labourers. The ownership of paddy lands which receive free irrigation water on the other hand appears to have acted as a disincentive to embark on lift irrigation especially among the Sinhalese farmers.

The family size of the farmers was also found to be an important factor that induces farmers to go for well irrigation. It is directly connected with the supply of labour for well excavation as well as with the cultivation of labour intensive cash crops. According to the information collected for the survey, the total number of members in a farm (including resident relatives) varied between 1 and 13. But the most frequent category was that of 5 - 8 members (fig. 9). However, the available information is hardly adequate to suggest that larger families had a greater tendency to go for well irrigation than the smaller families.

Land owned by an individual farmer in the 'highlands' was often found to be in a single block, and therefore presents an interesting contrast to the highly fragmented traditional *paddy* lands. As a part of the field survey, the acreage of the plots of land around each well was recorded. These records indicate that 79% of the plots were less than 4 acres in extent while only 1% of the farmers had plots as large as 4 - 5 acres.

The general compatibility of these figures with those of total land ownership discussed above corroborates the view that highland holdings are less fragmented. This reflected to a large extent the effect of the Land Development Ordinance which is designed to discourage among other things the practices leading to land fragmentation.

The proportion of land under irrigation around wells at the time of the survey was another important parameter which was recorded in the field. However since the survey took place during the dry season (in June, July and August) the irrigated land as expected was at its minimum extent. Thus only 59% of the farmers in the sample had some irrigated crops around their wells at the time of the visit. Of these farmers, the majority (57%) were irrigating parcels less than ½ acre in size. 26% of them had ¼-1 acre blocks while 13% had 1 - 2 acre blocks. Only 4% of the farmers who had some crops around their wells were irrigating blocks as large as 2 - 5 acres.

Having recorded the approximate extent of land under irrigation around each well, the farmers were asked to give reasons for not cultivating their entire blocks of land. As expected, a considerable proportion of the farmers who responded to this question gave inadequacy of water (32%) as the single most important impediment to dry season cultivation. However, it is interesting to compare the responses of farmers who gave more than one reason for not cultivating their entire block of land around the wells. A considerable number of farmers combined either 'not enough labour' or 'cannot bear investment cost' with the general problem of 'not enough water'. The same picture emerges, even if we go by the individual respones related to each constraint. For example, those who mentioned water as a constraint either singly or in combination with another factor represented 89% of the sample, those who mentioned lack of pumpsets as a constraint represented 30%, those who mentioned labour as a constraint represented 32% and those who mentioned capital as a constraint represented 39%. In fact, the lack of a pumpset is also a part of the problem of the lack of capital since it forms a basic item of capital investment. It appears therefore, that apart from the inadequacy of water, the lack of capital and the labour supply are the biggest constraints to the development of well irrigated agriculture in Vavuniya.

Although, the lack of capital is an obvious constraint which is not difficult to understand, the inadequacy of labour appears to be a much more complex issue. Can it be interpreted as an indication of the fact that more people can be absorbed to agriculture based on lift irrigation? Although, the seasonal migration of labour to this area exists at the times of harvest, a general inadequacy of labour for agriculture based on lift irrigation does not appear to agree well with the relatively large sizes of farm families already engaged in well irrigation, and who reported labour shortage as a problem.[10] High demands for labour in the cultivation of labour-intensive crops provides a partial explanation to this problem. However, it is likely that there are other unknown factors such as the age structure and the attitude of people to work, that contributes to the general inadequacy of labour. Whatever the actual reasons behind this state of affairs are, it is clear that well irrigation can be employment generating and perhaps provides a new approach towards the solution to the growing problem of unemployed youth in the rural areas.

Crops and Cultivation Practices

The names of at least 13 crops grown under well irrigation were mentioned by the farmers in the sample. These included chillies, groundnut, onions, paddy, vegetables, plantains, gingelly, cowpea, black gram and green gram, saffron, sugar cane and a variety of perennial crops. Of these crops, the most important monocultures were chillies, groundnuts and onions. However, interculture is a much more common practice where various subsidiary food crops are grown in combination with chillies which is unquestionably the most dominant crop in the area. Thus chillies and onions and chillies and groundnut appeared to be the most popular crop combinations. The dominant place occupied by the chillies at the time of the survey was mostly influenced by the favourable market conditions which prevailed during the preceding 2-3 years. Although the price of chillies fluctuated violently in the market in the mid 1970s, it always fetched a price which covered the farm costs and left a reasonable margin to the farmer. It is also a crop which could be kept in storage for several months without serious insect damage if properly packed. This helps the farmer at least in a small way to release the crop to the market when the prices become favourable.

During the rainy season (or *maha* season from October to December) almost all farmers grow highland rice which forms the staple diet of the people. Normally, the farmers use $\frac{1}{2} - \frac{3}{4}$ of their lands for cultivating rice during the wet season. The rest remains under vegetables and subsidiary cash crops. Although these subsidiary crops give way to rice during the *Maha* season, they become the dominant crops during the *Meda* season (or intermediate season, from January to April) and during the *Yala* season

10. Since the information collected during the survey relates only to the families of farmers practising well irrigation, it is not posible to say whether farmers with larger families had a greater propensity to go for well irrigation.

(or dry season from May to September). The irrigation wells are only occasionally used during the rainy season, especially when a crop failure is imminent due to the failure of monsoonal rains. Therefore, the major function of an irrigation well during the rainy season is as a supplemental or standby well which provides some form of insurance. Wells are heavily used during the intermediate season (*meda*) when the water table is relatively high and the supplies are quite satisfactory. In the dry season (*yala*), inadequacy of water in many wells restricts the extent of land irrigated and if the water supply becomes too poor, the farmer often gives up irrigation completely.

Income from the Lands under Lift Irrigation

The total declared incomes from crops grown with the help of well irrigation ranged from less than Rs. 500 to Rs. 20,000 per annum for farmers in the sample. However, the income of the great majority of the farmers (61%) varied between Rs. 1000 and Rs. 5000. While 16% of the farmers reported receiving incomes less than Rs. 1000, 22% of the farmers reported receiving incomes above Rs. 5000. This represents an average annual income of Rs. 3760 for a farmer in the sample. It also indicates an average return of Rs. 1545 for an acre of land irrigated by wells. However, in view of the rather skewed distribution of incomes, (see fig. 10) the average values do not bring out the full story.

Although no comparative information is available, field observations indicate that the level of income of an average farmer practising well irrigation was generally higher than that of his counterpart in the *purana* village who did not practice well irrigation. It would also be interesting to compare the income level of farmers practising lift irrigation with that of some categories of white-collar workers in the government service. It is recognized that such comparisons are notoriously difficult to make particulary due to dangers inherent in using declared farm incomes, and fluctuating market conditions. Fortunately, at the time of the survey, the price of chillies was more or less stabilized at Rs. 10 per pound and this helped to maintain some stability in the farm incomes. Bearing all these considerations in mind, if one attempts to make a broad comparison of farmers' and white collar workers' incomes, it appears that, if properly organized, well irrigation can easily attract people who would otherwise seek low paid jobs in the government service. Incomes earned by more progressive farmers who practice well irrigation also indicate that there is scope for an energetic farmer to earn incomes far higher than what he would be able to earn as a lowly paid junior government servant.

Farmer Perceptions

At the end of the interviews, two questions were asked on the perception of the farmers of the whole experience of the practice of well irrigation and its benefits. One question was whether the farmer considers his investment on well irrigation worthwhile. For this question, 61% of the farmers responded 'yes', while 35% said 'no'. About 4% of the farmers said they don't know whether to say 'yes' or 'no'. Those who gave a negative response were asked to give reasons for thinking that their investment was not worthwhile. The great majority of the farmers who responded to this question (89%) gave inadequacy of water as the overriding reason. The remaining 11% attributed it to a variety of reasons such as poor soils, the scarcity of labour etc.

The second question was whether the farmer would recommend the spread of well irrigation to other parts of the Dry Zone. In response to this question some 96% of the farmers said they would recommend this practice for the other part of the Dry Zone and surprisingly only 4 farmers (1%) maintained that they would not recommend it. The remaining 3% did not know what to say. However, the great majority of the farmers who recommended the spread of this practice added the rider that their recommendation applies only to places where water is available in adequate quantities.

Some Conclusions

It appears from the information presented in the foregoing analysis that the sample was more or less dominated by the 'landless' farmers (ie. the farmers who did not possess traditional paddy lands) with only highland allotments, and Tamil speaking respondents. It is therefore, likely that the results of the survey represent mostly the attitudes and perceptions of the above groups. Although the findings of the survey do not provide clear and conclusive answers to many of the questions involving well irrigation, they definitely throw much light on the issues under investigation.

(a) The degree of risk involved in excavating wells in the hard rock areas like Vavuniya is brought out by the likely chances of encountering the bedrock, the proportion of wells that run dry during the dry season, and the extent of irrigated crops around the wells at the time of the survey. The survey indicates that 19% of the wells run dry during the height of the dry season and 41% of the farmers had no irrigated crops around their wells at the time of the survey (i.e. in June, July and August 1977). It was noted that many of these 'dry wells' are used during the intermediate season by bottom borcholes and other methods. It was found that a farmer can be highly confident (97%) that he will not encounter the bedrock only up to a depth of about 3 metres from the surface and it becomes a gamble after reaching a depth of about 8 metres when excavating wells in the highland allotments.

(b) On the question of whether well irrigation is employment generating, the survey appears to provide a somewhat positive answer. Nearly 96% of the farmers in the sample had no traditional paddy lands and their major source of livelihood was the highland allotment which was made productive through well irrigation. It should be recalled that, among other things, one of the important reasons for not cultivating the entire block of land around the wells was the 'inadequacy of labour'. This indicates that more unemployed people can be absorbed to agriculture based on well irrigation, even at the present level of development. If the necessary agricultural capital and pumpsets could be provided in an organized way, well irrigation may prove to be a new avenue for unemployed youth in the rural dry zone.

(c) The information relevant to the hypothesis on whether farmers perceive well irrigation as an economically feasible venture indicates a pattern of mixed response. However, 61% of the farmers thought that their investment is worthwhile, and a large majority of them (96%) recommended the spread of the well irrigation practice to other parts of the dry zone if the water is adequately available. It should be emphasized that these are only farmers' perceptions and may not necessarily agree with the results of a conventional cost-benefit analysis which was not undertaken in this study.

A general consideration of the whole gamut of factors involved in agriculture based on well-irrigation in the country around Vavuniya demonstrates the fact that the present levels of income could be greatly improved through a more scientific siting of wells, a more rational choice of crops and the provision of more infrastructural and other facilities such as initial capital and farm implements, particularly the pumpsets and related services.

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