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Livestock as an effective asset for sustainable poverty reduction: a case study of Sindh, Pakistan

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Abstract In this paper, we have discussed essentially the following three issues. The first issue relates to the short-run nature of the on-going poverty reduction strategy. We have emphasized the importance of long-run approach to this issue. The second issue is on the importance of sustainability of improved income through policy intervention. We have focused on the role of livestock, in particular the river-type buffalo, as an effective rural asset for ensuring sustainability of the household income of small farmers. The third issue is on the workable and effective prescriptions for immediate policy action. The 'Buffalo Calves Salvation Scheme' is one of these.

Keywords Poverty reduction strategy, Sustainability, Rural asset, River-type buffalo, Cattle colony, Buffalo calves salvation scheme

JEL classification O13, O22, Q01

1 Introduction

In a country with high rate of population growth and dominance of young in the population structure, economic growth is essential for employment generation. However, it is our view that the growth strategy that does not contribute to improvement of socio-economic conditions of the society is counterproductive.

The kind of growth we expect in Pakistan is the one with higher employment elasticity. To be more specific, growth has to be more than 4% with the employment elasticity at 0.5[1]. It has to be labor absorptive, particularly in rural areas, where large stock of surplus labor has not been fully involved in the growth process.

Pakistan has not yet achieved a full-fledged industrial structure. However, regardless of the strategy for the development of non-agricultural sectors, the potential role of agriculture should not be underestimated.

The strength of Pakistan's agriculture, as we understand, is the existence of excellent agricultural infrastructure symbolized by extensive canal irrigation network and mixed farming systems, where the diversified crop and livestock sub-sectors are integrated into a single management system. This traditional farming system is much stronger in hedging against risk and uncertainty, and for achieving food-nutrient security.

Pakistan has now attained self-sufficiency in staple food production after the successful introduction of the so-called green revolution in the 1960s on the basis of the excellent agrarian infrastructure. However, in the absence of technological breakthrough in crop

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[1] We would like to share this view with the policy guideline adopted in the India' s 12th Five Year Plan. (GOI, State of Indian Agriculture, Ministry of Agriculture, 2011-12). It is clearly stated that achieving an 8-9 percent rate of growth in overall GDP may not deliver much in terms of poverty reduction, unless agriculture should grow at least 4% per annum. Unwritten assumption here is that the population is grow at the rate of 2 %, and the employment elasticity is assumed to be at 0.5.

production in recent years, the growth policy has been shifting towards livestock and horticultural sub-sectors, notably the former. To be more specific, the non-crop sub-sectors are expected to shoulder more responsibility of generating surpluses for economic development and to overcome problems of surplus labor and inter-regional disparity, as well as persistent poverty in rural Pakistan.

Under this broader framework of understanding, what we are going to discuss in this paper, which is based on our experience from the on-going JICA's (Japan International Cooperation Agency) project on Sustainable Livestock Development in Pakistan[2] can be spelled out as follows.

First, we expect the development of livestock sub-sector holds a key to achieve the required growth rate in agriculture and the stability of rural society. Second, we set our research and policy objectives as to enhance total household income in a diversified way, and asset holding position of the small-marginal farm households and the non-farm households (hereafter, we call them simply our target small farmers) in more sustainable manner. Third, in order to achieve our objectives, we will try to examine usefulness of the long-term asset-based approach in poverty reduction strategy. Fourth, we would like to propose the workable and effective schemes for doubling milk yield, and asset formation of small farmers.

Our empirical base of inquiry is the five districts in the Southern Zone of Sindh, which is one of the five zones we have initially classified for our project, involving Hyderabad, Karachi and two representative Cattle Colonies in the Province (JICA 2011)

2 An alternative approach toward poverty reduction

2.1 Income-based short-run approach toward poverty reduction

As we have already stated, social stability in the process of growth cannot be ensured under the growing inter- as well as intra-regional disparities and persistent poverty. In fact, poverty reduction has continued to be the top priority agenda for the international organizations since the 1990s. It remains so even in the Sustainable Development Goals adopted by the United Nations Summit of 2015.

On this issue, it is our perception that the ultimate emphasis of the poverty reduction strategy should be on termination of discrimination, alienation and segregation associated with persistent poverty. From this point of view, the enhancement of income is a necessary but not a sufficient condition for poverty reduction, as the improved income has to be sustained for a longer period of time, say one generation (Hirashima 1985)

2.2 Asset based long run approach toward poverty reduction

2.2.1 Major forms of rural assets

There is no census on rural assets in Pakistan. Therefore, we use Indian data as a proxy. According to this data, almost 90% of the rural assets in India are composed of three items viz., land, buildings and livestock (GoI 2006).

Land is by far the most important productive asset and a symbol of power and status in rural India and Pakistan as well. In addition, the 'price inelastic demand for land acquisition' has been observed for maintaining the 'Equitable Inheritance System'. As a result, the price of land has been increasing much faster than its productive worth. As we have discussed elsewhere, the land bubble has been formulated since the private ownership of land was established in the 1850s in the Greater Punjab by the British colonial government. Since then, the land price has gone up to the extent that it has become almost inaccessible for majority of small farmers (Hirashima 1978; 2008).

Buildings, such as houses for living, are also an important form of assets in rural areas. However, it is not the popular asset to generate rental income in a village community.

Amongst different forms of rural assets, it is the livestock that are the most accessible to our target small farmers. Livestock are a productive asset to generate

[2] The 5- year Project on the Sustainable Livestock Development in Sindh Pakistan by the Japan International Cooperation Agency (JICA) has started in February 2014, based on the Master Plan Survey conducted in July 2010 to March 2013. The broader objective is to improve the income and asset position of the small farmers by developing the appropriate technologies, thereby contributing to the growth and stability of rural Sindh in Pakistan.

income, a means to hedge against risk and uncertainty and a collateral to access credit from financial institutions.

2.2.2 Income asset disparity among rural households

Holding of assets is an important variable for examining the extent of social inequality. Let us show some empirical evidences from rural Pakistan. From a survey of four villages conducted in early 1970s, Hrashima (1978) has found disparity in asset holdings more conspicuous than in income among farm households of different categories of land tenure, and between farm households (Zamindars) and non-farm households (Kammees). For instance, by taking the average income per household of owner farmer as 100, the level of income of a tenant farmer, blacksmith (Lohar), carpenter (Tarkhan), and agricultural laborer (Murassi) was 48.4, 25.5, 23.5 and 19.2, respectively. While, the level of rural assets per household (land, building, livestock and farm machineries) was only 6.9, 3.9, 5.6 and 1.4, respectively (Hirashima 1978).

Although we do not have any comparable data at village level in India, we found similar evidence at state level, where the average level of asset holding of the non-cultivators in rural India (similar to Kammees in Pakistan) was only 27% of that of the cultivators; 14% for agricultural laborers, 23% for the traditional artisans, and 41% for those engaged in other non-farming activities. Likewise, we found similar evidence among the different caste groups in rural India. By taking the level of asset holding of the higher caste group as 100, the average level of assets held by SC (Schedule Caste), ST (Schedule Tribe) and OBC (Other Backward Classes) was 28, 32 and 62, respectively (GoI 2006; Hirashima 2009) From a different perspective, Vaidyanathan (1990) also found that the consumption-asset ratio in rural India at state level had declined during 1961-62 to 1981-82 (Vaidyanathan 1990).

Figure 1 shows the state of disparity in a village of JICA's Project area in Sindh, Pakistan, in terms of Gini-coefficient, and figure 2 shows the case of India at state level. Although, these figures are not strictly comparable, these are sufficient to suggest that the disparity in asset holding has been more than that for income/consumption over time and space.

These findings lend support to the effectiveness of asset-based approach, in addition to the income/

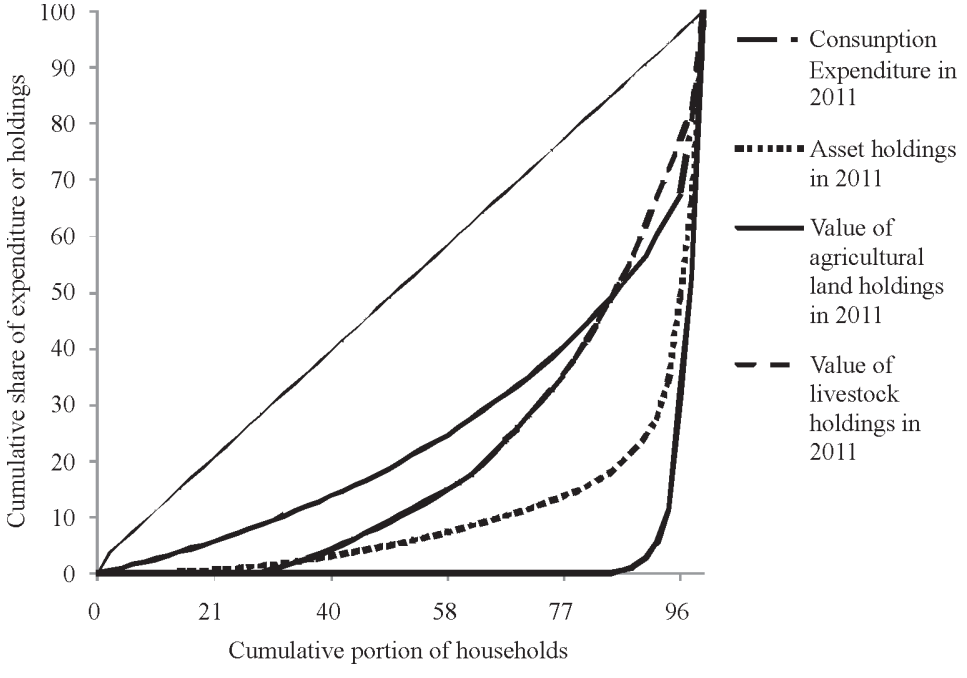

Figure 1. Lorenz curves of consumption, income, and assets in a village in the project area, Sindh, Pakistan, 2011
Source: The Project for the Master Plan Study on Livestock, Meat and Dairy Development in Sindh Province in the Islamic Republic of Pakistan, Baseline Survey (2011)

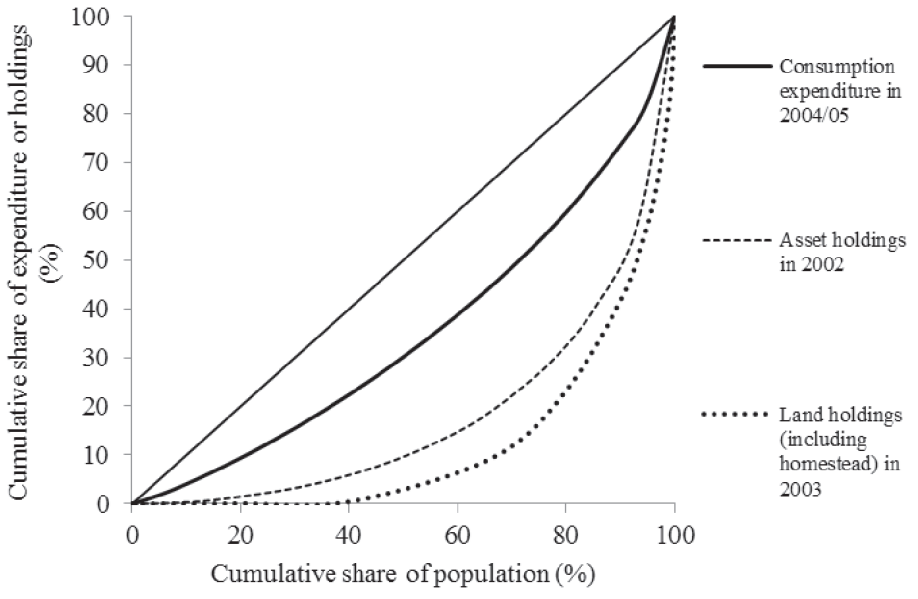

Figure 2. Lorenz curves of consumption, income, and asset in rural India
Source: Computations based on NSSO

consumption-based approach toward poverty reduction.

3. Livestock as an effective asset for sustainable poverty reduction for small farmers.

3.1 The vital role of livestock sector

The agricultural sector in Pakistan needs to grow more than 4% with an employment elasticity of at least 0.5 in order to achieve the inclusive growth and social stability. However, the performance in this regard has not been encouraging in recent years in the face of declining share of the crop sub-sector in agricultural GDP and its growth rate. As a result, the role of livestock sub-sector in enhancing growth and stability has been recognized widely.[3]

In the midst of academic works still focusing on the development of crop sector, we have a limited number of valuable studies in line with our approach. Kurrosaki (2001) concisely summarizes the significant roles of the livestock sector, based on the detailed village studies in KP (Kybaar Pakhtunkha) and Punjab in Pakistan. These are, (1) labor/ leisure smoothening, especially for females, through daily livestock care; (2) cash liquidity smoothening through milk income flow; (3) a precautionary saving role, since livestock is a liquid form of wealth; and (4) direct consumption of high quality in the form of milk and milk products (Dahi, Ghee, Lassi, Paneer, etc). He has concluded that, the given incompleteness of rural markets, livestock holding is a key to the sustainability of rural household economy at the micro level. In India, Birthal and Negi (2012), in their recent study, articulated the role of livestock sector in ensuring sustainable and inclusive agricultural growth.

We are in full agreement with the direction of the recent government policy and the effort of the academic community. What we have to do next is to step forward to examine feasible solutions on the basis of empirical realities. The JICA's project on 'Sustainable Livestock Development in Rural Sindh, Pakistan', as we will discuss in the following sections, is one of our prescriptions for the next step.

[3] The agricultural growth rate of Pakistan was 6.09 in the 1980s, but it was reduced to 3.86 in the 1990s and continued to be lower than 4% up to the present time (2007/08 – 2013/14). As for the employment elasticity of agriculture, the Planning Commission's estimate is 0.37 for the period of 1990s – 2000s. The share of the livestock to GDP is 11% now, which is now higher than that of the major crops (GoP, Economic Survey, 2016/ 17)

3.2 Cattle and buffaloes in Pakistan's agriculture

Livestock in Pakistan include cattle, buffalo, goat, sheep, camel and poultry. Among these, cattle and buffalo are more important in terms of value addition and sustainable productive rural assets. Therefore, the evidence in this paper is confined to cattle and buffaloes, more specifically the milk producing cows and she-buffaloes.

The role of livestock in Pakistan's agriculture has undergone substantial change over time. In fact, the livestock in the mixed farming system originally meant a pair of bullocks for plowing and source of power for other activities, such as transportation. However, with the rapid development of farm mechanization after the 1960s, the importance of bullocks has gone down sharply. Instead, the milch animals have gained in their important role of ensuring food-nutrient security.

As of 2016, India held the second position in terms of cattle population (186.0 million), next to Brazil (218.2 million). Pakistan was at the tenth position (42.8 million). However, the global picture changes drastically, if the buffalo population is added. For example, India becomes at the top (299.3 million) and Pakistan gains 4th position (79.4 million) after India, the USA and China. In fact, India's buffalo population (112.3 million) alone was more than the cattle population of the USA and China in 2016, and Pakistan's buffalo population (36.6 million) was more than the cattle population of Australia (FAOSTAT 2016).

The addition of buffalo (unless specified, buffalo hereafter means she-buffalo) gives rise to the question of comparability in terms of total milk production and average yield between countries with buffalo population and those without buffalo. This is caused by the difference of fat content between cow milk and buffalo milk, while there is not much difference in SNF (solid non-fat) between these two. The fat content in buffalo milk is at least two times higher than in cow milk, while the SNF is a little over 8% in both. It simply suggests that it is not appropriate to make international comparison in terms of total milk production and yield between countries with and without buffaloes in quantity terms. If the total production in quantity terms were the same between the two countries with and without buffalo population, it is obvious that the value addition would be much higher for the former.

Now, despite the fact that the buffaloes in Pakistan are contributing much more than the cows to milk production and value addition, they have not benefitted from the advancements in technologies from abroad; since the river-type buffaloes have not been popular in any advanced dairy country, with a minor exception of Italy and Bulgaria. The buffaloes in Pakistan, as compared with the cows are said to have of (i) late age of maturity, (ii) long calving interval, and (iii) silent heat (Bilal et al. 2006). Besides, the developments in technology and management such as artificial insemination (AI) have also lagged behind in buffaloes. It could mean, however, that the potential of buffaloes in terms of production and productivity has not yet been fully tapped in Pakistan. These are reasons behind our focus on the development of appropriate technologies for buffalo in our Project.

3.3 The structure of livestock sector in Sindh, Pakistan

In Pakistan, cattle population is more than that of buffalo population at macro level. However, this is true only for the provinces with hills and mountains such as KP and Balochistan. The major agricultural provinces with extensive canal irrigation network, such as Punjab and Sindh, have more buffalo than cattle. The same is true for milk production. For example, 44.4 million cows in 2016-17 produced 20.1 million tons of milk, while 37.7 million buffaloes produced 34.1 million tons. However, if the level of fat content is standardized at 3.5% (most popular fat content of liquid milk for consumption), the buffaloes contribute much more to value addition than being expressed in physical terms.

Confined to the characteristics of the two major milk producing provinces, Punjab and Sindh, the former enjoys absolute advantage in terms of livestock population as well as milk production. However, as indicated in table A1 in the appendix, the livestock sector of Sindh looks comparatively more important for rural economy, in particular for small farmers. Also, table A2 in the appendix shows the indicators are advantageous for Sindh, for example the proportion of cows and buffaloes in-milk in total population. Unfortunately, we could not find any data to alter the situation in recent years.

In Sindh, cows and buffaloes are reared by the following four categories. The first category is represented by the medium-large farm households (including landlords) who keep, in general, high producing cows and buffaloes in the mixed farming system. Many of them are innovative farmers and local leaders as well. The second category is a limited number of professional breeders and large-scale commercial dairy farms. They are the main suppliers of high producing livestock to markets, and are located in rural areas. The third category is our target small farmers for poverty reduction strategy. To be more specific, they are the small-marginal farm households (including tenants), whose operational holding is less than 2 hectares, and they keep low producing cows and buffaloes in the mixed farming system. If we extend our target group to the resident non-farm households and the lower-medium size farmers (less than 3 ha), around 70% of the total rural Sindh falls into this category. The fourth category is represented by the Livestock Holders (named in the Livestock Census of Pakistan 2006) in the Cattle Colonies. They are the large-scale professional providers of milk to urban consumers. Currently, there are three Cattle Colonies in Sindh: Karachi, Hyderabad and Sukkur. Among these, Karachi Cattle Colony is, probably the largest one in the world of its kind, keeping over one million cows and buffaloes with buffaloes comprising as high as 83%. All of them are in-milk and cared by 7,525 Livestock Holders. Average size of herd comes to 139, and the average yield 8 to 9 kg per day (table A3 in the appendix). It is important to notice that the Karachi Cattle Colony alone meets the substantial portion of the consumption need in terms of liquid milk and dairy products of the people in the Metropolitan Karachi (22.8 million in 2016).[4]

What should be noticed in the Cattle Colonies is that a majority of Livestock Holders are not keeping the newly-born buffalo calves and dry buffaloes in the Colonies. This is mainly due to the high mortality rate, space constraint, and also due to the lack of diagnosis and the treatment of reproductive disorders. In fact, as shown in table A3 in the appendix, all cows and buffaloes are in-milk and thus there are neither young animals nor animals not yet calved in the Cattle Colonies. It implies that the present management system looks efficient in terms of maximization of profit by keeping only cows and buffaloes in-milk and by disposing off the unproductive calves and dry buffaloes on the other hand. Admitting the important role of the Cattle Colonies in terms of generating marketable surplus for urban consumers such as the Metropolitan Karachi, these are not efficient, however, in terms of total resource management from a long – run perspective (Khan et al. 2008).

3.4 Dual structure of productivity in the livestock sector in Sindh

During our master survey, it came to our notice that there are two distinct levels of productivity in the livestock scetor. One is the productivity of the farm households rearing cows and buffaloes under the mixed farming system (category (i), (ii) and (iii)) and the other is the category (iv) of the Livestock Holders in the Cattle Colonies. In order to verify this, we conducted an extensive field survey in eight districts which were selected considering regional characteristics (Karachi, Badin, Tharparkar, Jamshoro, Sukkar, Larkhana, Tando Allayar, and Sanghar). Then, six villages were selected from each district, and finally, 15 farm households were selected from the three stratified categories in terms of size of land holding, i.e., small, medium and large. However, from Karachi, only three Cattle Colonies of different sizes and 3 villages were selected. On the whole, 675 farm households and 45 Livestock Holders in the Cattle Colonies were surveyed. Figure 3 shows the outcome of the survey.

From figure 3, we could identify two distinct curves having different peaks; around 4 kg for the farm households and around 8 kg for the Livestock Holders in the Cattle Colonies. Diversity in productivity is observed among the farm households, while the productivity in Cattle Colonies is concentrated around the mean.

It, thus, becomes clear from this finding that the policy objective should be to double the productivity of milk

[4] The Cattle Colony may better be called the Buffalo Colony or Dairy Colony, since the majority of animals kept are buffaloes than cow. The first and the largest Colony is Landhi Cattle Colony in suburban Karachi was established in 1058/59 where a million of cows and buffaloes are producing milk exclusively for urban consumption. In detail, see the pioneering study by Nakasato (2006).

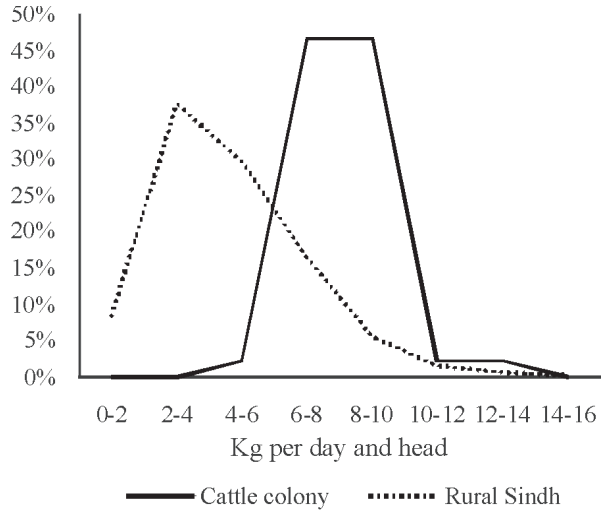

Figure 3. Dual structure of milk productivity in rural farm households and Cattle Colonies in Sindh, 2011
Source: Data from the field survey.

from 4 kg to 8 kg for the majority of our target small farmers in Sindh.

4 Schemes for doubling productivity on small farmers

4.1 Productivity enhancement through improvements in feed and management

The most conventional method of increasing productivity is to improve the genetic characteristics of livestock and the other is to improve feed and management (Iqbal & Ahmad 1999; Bilal et al. 2006).

As for the genetic enhancement is concerned, while the high-producing exotic breeds of cow, such as Holstein and Jersey are available for crossbreeding of indigenous breeds, but it is not the case for buffalo. Therefore, the pure-line selection is the main option for buffalo at the moment. In this case, we know two high producing elite breeds of buffalo in Pakistan: Nili-Ravi and Kundi. According to the Special Report of the Livestock Census 2006, 55% of the total population of Nili-Ravi was in Punjab, and its average productivity (yield) was 8.2 kg per day, while 73% of the population of Kundi was in Sindh with an average productivity of 8.9 kg per day.

We do not have enough knowledge on the accountable factors for this pattern of distribution. Therefore, we are not in a position to suggest appropriate direction of change, except for the necessity and urgency of developing the artificial insemination (AI) technology and to improve the capacity of male-buffalo for breeding. Based on our record keeping exercise of 117 Kundi buffaloes for two years maintained by one Livestock Holder in Hyderabad Cattle Colony, we found a noticeable standard deviation around the mean milk yield even with the same feeding and management regime. Only variable we could not control was the capacity of male-buffaloes used for breeding (figure A1 in the appendix).

As for the second measure of productivity enhancement is concerned, we are proposing two schemes; one is the enhancement of productivity through improvement of quality of feed and management, and the other through the 'Buffalo Calves Salvation Scheme'.

Let us begin with our feed trial at Mr. M's farm who is one of our pilot farmers in Matiali district in Sindh. Mr. M is an owner of 1.2 ha of land, categorized as our target small farmer, and owned 8 buffaloes in-milk at the time of our record keeping survey for two years. The results are presented in table 1 and figure 4.

We maintained yield record of all the buffaloes in - milk for two years. The total buffaloes kept by Mr. M were 8, but the buffalo with Tag no.252 was given formula feed for two consecutive years. Also, the buffalo with Tag no. 251 was given conventional feed in 2015 and formula feed in 2016. In general, we could confirm that the yield level gets doubled from around

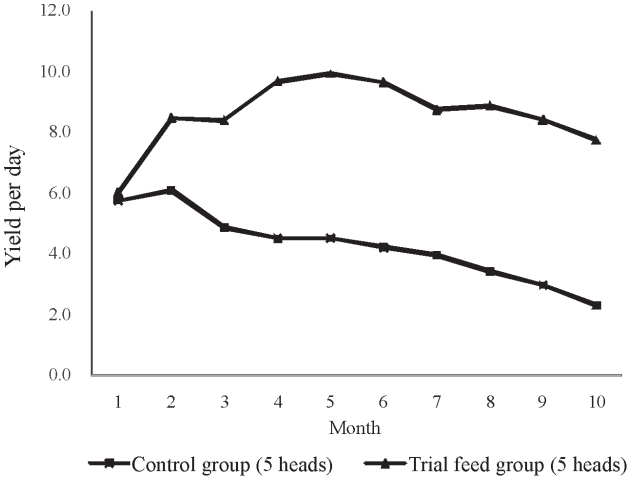

Figure 4. Average yield between the Group of Control (conventional feed) and the Group of Trial Feed (formula feed)
Source: As for table 1.

Table 1. Yield effect of the newly developed formula feed tested at the pilot farm, Matiali district, Sindh, 2015-2016

Tag number	Month										Mili yield/day (Kg)	Milk production in 305 days (Kg)
	1	2	3	4	5	6	7	8	9	10		
Group of Control 5 heads												
No.247	2.5	2.7	3.0	4.0	3.7	4.5	3.9	4.5	4.5	3.4	3.7	1,118
No.249	7.0	7.0	6.4	6.4	5.7	4.5	4.5	4.1	3.5	2.0	5.1	1,557
No.251	6.5	6.5	5.4	4.1	3.6	4.2	3.8	2.9	2.0	2.0	4.1	1,251
No.255	6.5	6.5	5.4	4.1	3.6	4.2	3.8	2.9	2.0	2.0	4.1	1,251
No.257	6.2	7.7	4.1	3.9	5.9	3.6	3.8	2.6	2.8	2.0	4.3	1,301
Average yield/day	5.7	6.1	4.9	4.5	4.5	4.2	4.0	3.4	3.0	2.3	4.2	1,295
Group of trial Feed 5 heads												
No.252	4.6	6.0	7.9	10.3	8.8	10.3	8.3	9.6	9.0	5.2	8.0	2,440
No.252	4.0	9.8	11.0	11.4	11.7	10.5	11.1	10.6	10.5	9.5	10.0	3,053
No.251	5.0	7.8	7.7	8.0	10.5	10.5	9.3	9.5	5.5	9.0	8.3	2,525
No.242	8.0	7.5	7.0	8.2	10.0	7.4	7.0	7.6	9.0	8.0	8.0	2,431
No.263	8.4	11.2	8.3	10.4	8.6	9.5	8.0	7.0	8.0	7.0	8.6	2,635
Average yield/day	6.0	8.5	8.4	9.7	9.9	9.6	8.7	8.9	8.4	7.7	8.6	2,617

Source: Data from the Record Keeping Survey.

4 kg to around 8 kg with feeding of formula feed. In particular cases, we could see that the yield level of the second time of birth is more than the first time (Tag no.252), and also, we can see the more assured evidence on the effect of the newly developed formula feed (Tag no,251). Although the sample size is too small to be conclusive, the outcome of our trial gives us a hope that there is a scope to double the animal productivity through the improvement of feed and management.

4.2 Buffalo Calves Salvation Scheme

4.2.1 Background

As already explained, a majority of the new-born calves in the Cattle Colonies is not given a chance to survive due to the high infant mortality rate, space constraint and longer gestation period of three years or more before they start producing milk. We thought we could double the yield of milk of our target small farmers, if these calves were given an opportunity to survive at their farms in rural areas. Since those calves were born from the highly productive mothers at the Cattle Colonies, we could expect them to produce as much as their mothers, although it may take three years or more to do so. Given the fact that the average yield of buffaloes kept by our target small farmers being around 4 kg per day, we would be able to achieve the target of doubling the yield and asset formation of our target small farmers, if we could formulate such a scheme.

Let us overview our Buffalo Calves Salvation Scheme.

- The breeders and the innovative medium-large farm households (including landlords) supply high yielding buffaloes to the livestock markets on commercial basis.
- The Livestock Holders in the Cattle Colonies procure these high yielding pregnant buffaloes from livestock markets in Sindh and Punjab with their discerning eyes.
- The majority of the Livestock Holders cannot afford to keep the new-born calves for the reasons already explained. The Project procures those calves for intensive care at the newly established Buffalo Calves Salvation Centre (BCSC) under the Department of Livestock and Fisheries. This preparatory step is important due to the fact that the mortality rate of the calves is extremely high for three months after birth.
- After the intensive care for three critical months at the BCSC, these calves are distributed to our target small farmers for rearing at their own farms.
- Under this scheme, our target small farmers are given an opportunity to obtain the buffalo whose productive capacity is twice as high as what they currently maintain. It implies that the share of livestock in the total household income will increase substantially and their asset holding

position will improve in a sustainable manner (figure 9).

- It is highly plausible that the yield may not come up to the expected level of 8 kg per day, under the poor quality of feed and management. However, we are hopeful that the yield could be doubled if the beneficiary small farmers start giving the newly developed formula feed and follow improved management practices.

4.2.2 Economic feasibility

Since 2014 onward a total of 96 Kundi buffalo calves were distributed to our target small farmers (mostly Pattern I). Although we are still in the process of devising a variety of patterns of distribution. Let us show the economic feasibility of two types of distribution: Pattern I and II.

In estimating the economic feasibility, we have adopted a cash flow analysis for two basic empirical reasons; availability of a sufficient stock of surplus labor, in particular the female labor, and the shortage of liquidity under the current state of underdeveloped rural credit and insurance markets in Pakistan.

Our estimation is based on the following data and assumptions:

(i) Cost of procuring a newly born buffalo calf: Rs. 2,500.

(ii) Cost of intensive care at the BCSC for 3 months: Rs. 20,000.

(iii) Expected first delivery: 42 months.

(iv) Second delivery after the first one: 2 years.

(v) Average yield per day for 305 days a year: 8 kg.

(vi) Selling price of milk per kg: Rs.60.

(vii) Cost of feeding: Rs. 1,650 per month of roughage, and additional Rs.4,000 per month during milking period for proving 4Kg/day of concentrate.

(viii) Expected selling price after 36 months: Rs. 80,000.

(ix) Expected selling price at 10th year: Rs. 85,000.

The internal rate of return is calculated as the value of r that satisfies the following equation: $\sum_{n-0}^{N} \frac{C_n}{(1+r)^n} = 0$

Where, the series of cash flows provides values for C_n and N is the number of years over which the returns are calculated.

The data and assumptions are quite conservative, particularly those listed as (iii) and (iv). Moreover, we have not considered the probable gains to be obtained, if the newly born calf were a female from the grown-up calf distributed under the Project. The estimated internal rate of return in two patterns is shown below.

Pattern I

The Project procures two buffalo calves from the BCSC and distributes them to our target small farmers free of charge under the condition that one calf is to be returned to the Project after 36 months to cover the all expenses incurred for three months. The internal rate of return comes to 25% (table 2, figure 5 & 6).

Table 2. Cash flow of a farmer for Pattern 1

Year	Cost to rear	Revenue of selling milk	Revenue of selling livestock	Total revenue	Net profit	Accumulated net profit
1	39,600	0	0	0	-39,600	-39,600
2	39,600	0	0	0	-39,600	-79,200
3	39,600	0	0	0	-39,600	-118,800
4	59,800	146,400	0	146,400	86,600	-32,200
5	19,800	0	0	0	-19,800	-52,000
6	59,800	146,400	0	146,400	86,600	34,600
7	19,800	0	0	0	-19,800	14,800
8	59,800	146,400	0	146,400	86,600	101,400
9	19,800	0	0	0	-19,800	81,600
10	59,800	144,000	85,000	229,000	169,200	250,800
Total	417,400	583,200	85,000	668,200	250,800	0

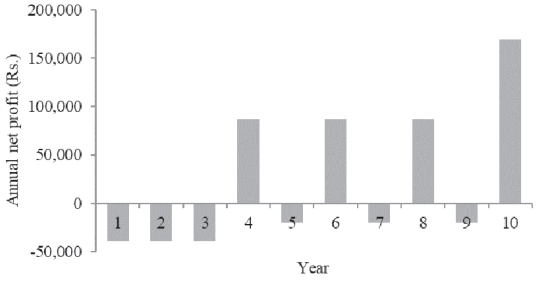

Figure 5. Annual net profit of a farmer for Pattern I

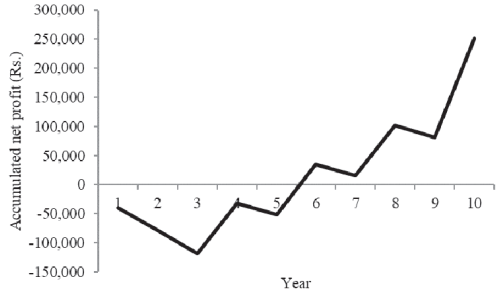

Figure 6. Accumulated profit of a farmer for Pattern I

Pattern II

Our target small farmers directly procure a calf from the BCSC with his own resources and rears for ten years at his farm. The internal rate of return becomes 35 % (table 3, figure 7 & 8).

In both cases, it gives us a clear message that it is empirically feasible to improve income and asset holding position of our target small farmers through our Buffalo Calves Salvation Scheme. In fact, as of today, it is reported that the mortality rate of the

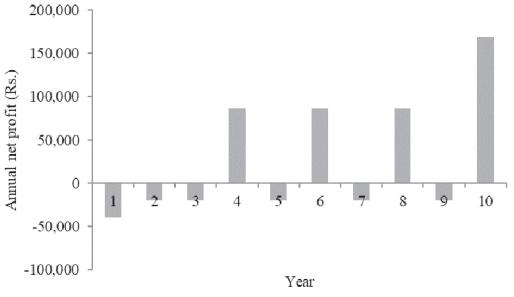

Figure 7. Annual net profit of a farmer for Pattern II

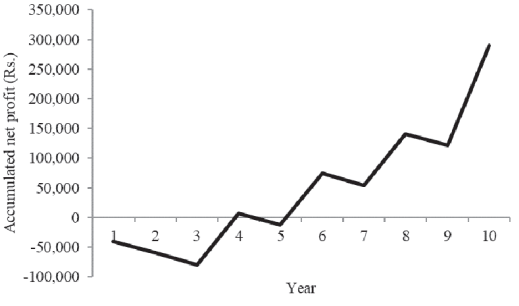

Figure 8. Accumulated profit of a farmer for Pattern II

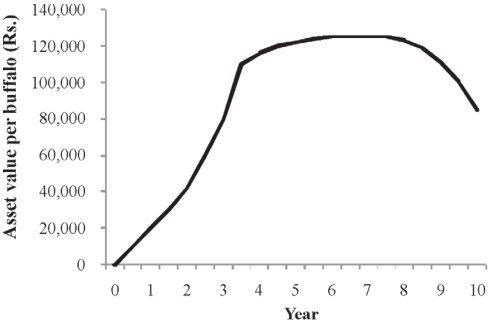

Figure 9 Asset value curve for a buffalo
Source: Provided by the Livestock Department, Sindh: year-wise market value of buffalo.

Table 3. Cash flow of a farmer for Pattern II

Year	Cost to rear	Revenue of selling milk	Revenue of selling livestock	Total revenue	Net profit	Accumulated net profit
1	39,800	0	0	0	-39,800	-39,800
2	19,800	0	0	0	-19,800	-59,600
3	19,800	0	0	0	-19,800	-79,400
4	59,800	146,400	0	146,400	86,600	7,200
5	19,800	0	0	0	-19,800	-12,600
6	59,800	146,400	0	146,400	86,600	74,000
7	19,800	0	0	0	-19,800	54,200
8	59,800	146,400	0	146,400	86,600	140,800
9	19,800	0	0	0	-19,800	121,000
10	59,800	144,000	85,000	229,000	169,200	290,200
Total	378,000	583,200	85,000	668,200	290,200	0

distributed calves has been only 1% and has benefitted small farmers improving their income and asset positions as we have envisaged. It is further reported that by seeing the results of this Scheme, one big NGO, based in Karachi, has established the similar BCSC, with our guidance and technical support; has been able to distribute 25 calves to the small farmers so far, and ready to expand the facilities. This is a positive sign we would like to share.

We have been discussing the possible support of the micro-finance institutions to our scheme. However, we have come to realize that the most critical bottleneck in this regard has been the matter of mutual confidence between the two parties, since unlike the case of crops, buffalo calf does not generate any output for at least three years. One possible solution would be the introduction of the livestock insurance scheme by the government to help reducing the uncertainty felt by the concerned parties. In fact, we have observed that the livestock insurance scheme has already been introduced by the Dairy Co-operative Societies in India, which deserves scrutiny for further development of this scheme.

5 Concluding remarks

In order to achieve inclusive growth with social stability, improved income and asset holding position have to be sustained for a longer period of time for the majority of small farmers in rural areas. This is the basic perception behind our JICA's Project on the Sustainable Livestock Development in Sindh, Pakistan.

The JICA's Project was originally designed for the development of appropriate technologies relevant for each category of livestock rearers, with special reference to our target group of small farmers. For us, livestock meant cattle, not buffalo when we started the Master Survey. However, we soon realized that buffalo has more technical problems than cow, despite its potential capacity. This is the reason why we have focused on the development of appropriate technologies and management for buffaloes in our Project. This approach is justified for the reason, unlike the case of cattle, that the new advanced technologies are not coming from outside for buffaloes; since no advanced country has buffaloes.

In an attempt at searching for the effective avenue towards productivity enhancement for our target small farmers, we had to answer two critical questions. One is to find the way to enhance productivity of livestock, and the other is how to formulate asset for our target small farmers whose income is too low to buy an adult animal.

Fortunately, we have discovered resource for meeting our dual objectives at the Cattle Colonies in our Project area, where most of the newly born buffalo calves (around one million) have not been kept in the Colonies. Since most of the wasted female buffalo calves in the magnitude of 0.5 million per year are from the highly productive mothers (over 8 kg per day), our Buffalo Calves Salvation Scheme could supply at least 0.25 million productive buffalo calves from the Cattle Colonies alone for our target small farmers in a year, which may not be possible in the current government R&D system.

Our Scheme may be too special to be generalized. We have faced also the sever reality that there are farmers who could not afford to buy the feed to rear, even if the buffalo calves were distributed free of charge. In this regard, we are trying to introduce 'tree crops' (fruits and a limited number of industrial crops, such as rubber and coffee) as more accessible assets for the poorest rural households in KP, Pakistan, the result of which will be our next paper. Nevertheless, we would like to claim that our Paper is one example to show how to capitalize the available untapped resources for the benefit of the asset-poor small farmers in rural area.

We have had no space to introduce all of our findings and schemes in this paper, such as the Dry Buffalo Salvation Scheme. We are hopeful to introduce them in our separate paper soon.

Acknowledgement

The authors are grateful to the devoted contribution of all those who have participated in the JICA's project on the Sustainable Livestock Development in Sindh, Pakistan, in particular to Dr. Ghulam Sarwar. We are also indebted to Professor Takashi Kurosaki for his comments for the first draft, and Professor Pratap Birthal for his constructive comments and guidance for improving the final draft.

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Table A1. Share of livestock in total household income in rural Punjab and Sindh, Pakistan (%)

Farm size	Punjab			Sindh		
(Ha)	Own Farm	Livestock	Others	Own Farm	Livestock	Others
-0.5	75.0	1.0	24.0	90.9	0.9	8.2
0.5 - 1.0	87.2	0.6	12.2	90.4	0.6	9.0
1.0 - 2.0	91.3	0.5	8.2	90.9	1.1	8.0
2.0 - 3.0	93.8	0.4	5.8	89.7	2.1	8.2
3.0 - 5.0	95.0	0.5	4.5	86.8	3.0	10.2
5.0 - 10.0	95.7	0.7	3.6	82.7	5.7	11.6
10.0 - 20.0	96.3	0.5	3.2	78.5	8.2	13.3
20.0 - 40.0	96.8	0.3	2.9	79.4	7.5	13.1
40.0 - 60.0	98.3	0.0	1.7	85.4	4.8	9.8
60.0 -	94.1	0.0	5.9	81.1	5.4	13.5
Total	89.3	0.6	10.1	88.1	2.5	9.4

Source: Calculated from Pakistan Agricultural Census 2000

Table A2. Particulars about cows and buffaloes in Punjab and Sindh, Pakistan in 2006 (1,000 heads, %)

	Punjab	Sindh
< Cow >		
1. In milk	4,050	2,143
2. Dry	2,479	996
3. Not yet calved	847	517
4. Young cow	2,662	1,040
5. Cow Total	10,038	4,696
6. (2)/(1)	61.2	46.5
7. (3)/(1)	20.9	24.1
8. (4)/(1)	65.7	48.5
9. (1)/(5)	40.3	45.6
< Female buffalo >		
1. In milk	6,233	3,051
2. Dry	2,352	808
3. Not yet calved	1,311	533
4. Young female buffalo	4,506	1,517
5. Female Buffalo Total	14,402	5,909
6. (2)/(1)	37.7	26.5
7. (3)/(1)	21	17.5
8. (4)/(1)	72.2	49.7
9. (1)/(5)	42.3	51.6

Source: Calculated from Livestock Census of Pakistan, 2006

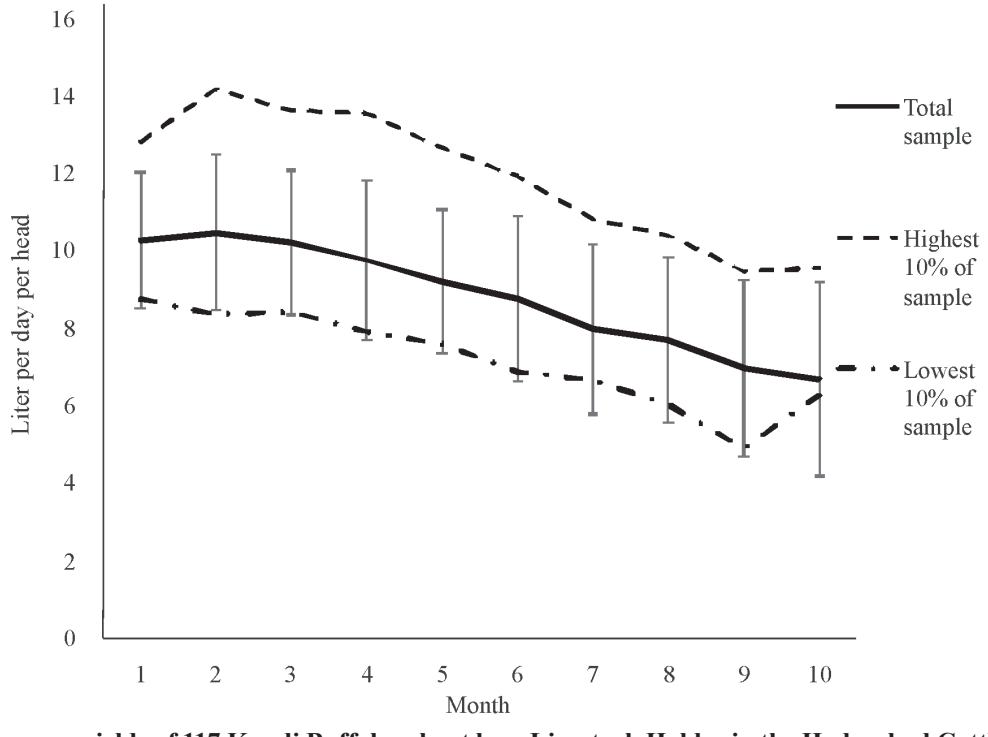

Figure A 1. Average yields of 117 Kundi Buffaloes kept by a Livestock Holder in the Hyderabad Cattle Colony with Standard Deviation around the Mean (2010 – 2012)
Source: JICA's Project on Sustainable Livestock Development in Sindh Pakistan.

Table A3. Basic data on Cattle Colonies in Sindh, Pakistan

Name of cattle colony	Number of cow	Number of buffalo	Number of cow and buffalo	Number of livestock holders	Milk production (kg per day)
Karachi					
Landhi Cattle Colony Karachi and Surroundings	40,000	385,000	425,000	3,000	3,825,000
Nagori Co-Operative Dairy farming Society Super Highway	5,000	18,000	23,000	120	207,000
Bilal Cattle Colony Korangi Karachi	2,500	15,000	17,500	85	157,500
Surjani Town Cattle Colony and Surroundings	3,000	12,000	15,000	70	135,000
Al-Momin Cattle Colony Gaddap and Surroundings	12,000	18,000	30,000	95	270,000
Al-Madina Cattle Colony Super Highway and Surroundings	13,000	28,000	41,000	70	369,000
Memon Cattle Colony Super Highway Karachi	7,000	52,000	59,000	85	531,000
Baldia Cattle Colony	9,000	31,000	40,000	700	360,000
Hub Road, Mawach Goth,Saeed Abad, Rashid Abad, Bakra Piri, Faqir Colony and Surroundings					
Orangi Town	9,000	71,000	80,000	800	720,000
Other Small Diary Farming in the Karachi City (Sultan Abad, Malir, Punjab Colony, Sherin Jinnah colony, Dehli Colony, Gulshan-e-Iqbal, Gulistan-e-Johar, Nazim Abad, Kemari, Maripur, Hocks Bay road)	55,000	200,000	255,000	900	2,295,000
Karachi Rural areas up to Mehar Jabbal. (Gaddap Town)	13,000	8,000	21,000	500	189,000
Estate - 2 Memon Goth Malir and Surroundings.	7,000	30,000	37,000	1,100	333,000
Karachi Total	175,500	868,000	1,043,500	7,525	9,391,500
Hyderabad					
Old cattle colony	1,500	19,000	20,500	105	164,000
New cattle colony	700	11,500	12,200	80	97,600
Hyderabad Total	2,200	30,500	32,700	185	261,600
Sukkur					
New + Old cattle colony	700	4,500	5,200	50	41,600

Source: Compiled by Dr.Nasrullah Panhwar (Department of Livestock and Fisheries, Sindh, Pakistan)